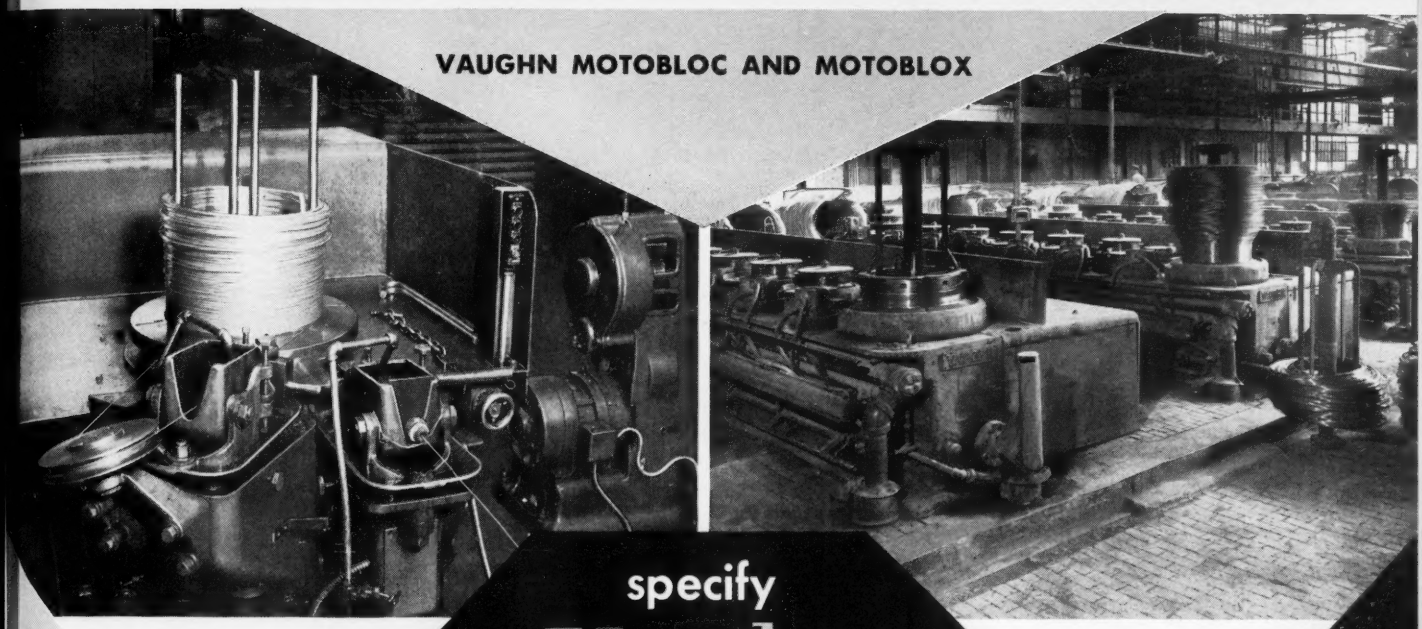
WIRE AND WIRE PRODUCTS

MAY 1949



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Vaughn

WIRE DRAWING MACHINERY

and you gain

Coverage

for every product demand!

"Quick on the Draw!"

VAUGHN MACHINERY

Profitably used by leading wire mills since 1871

Speed, versatility and dependability combine in Vaughn Machinery to give you complete coverage of every wire production requirement. You can *deliver* with Vaughn . . . may we consult with you?

THE VAUGHN MACHINERY COMPANY

CUYAHOGA FALLS, OHIO, U. S. A.

COMPLETE COLD DRAWING EQUIPMENT—Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

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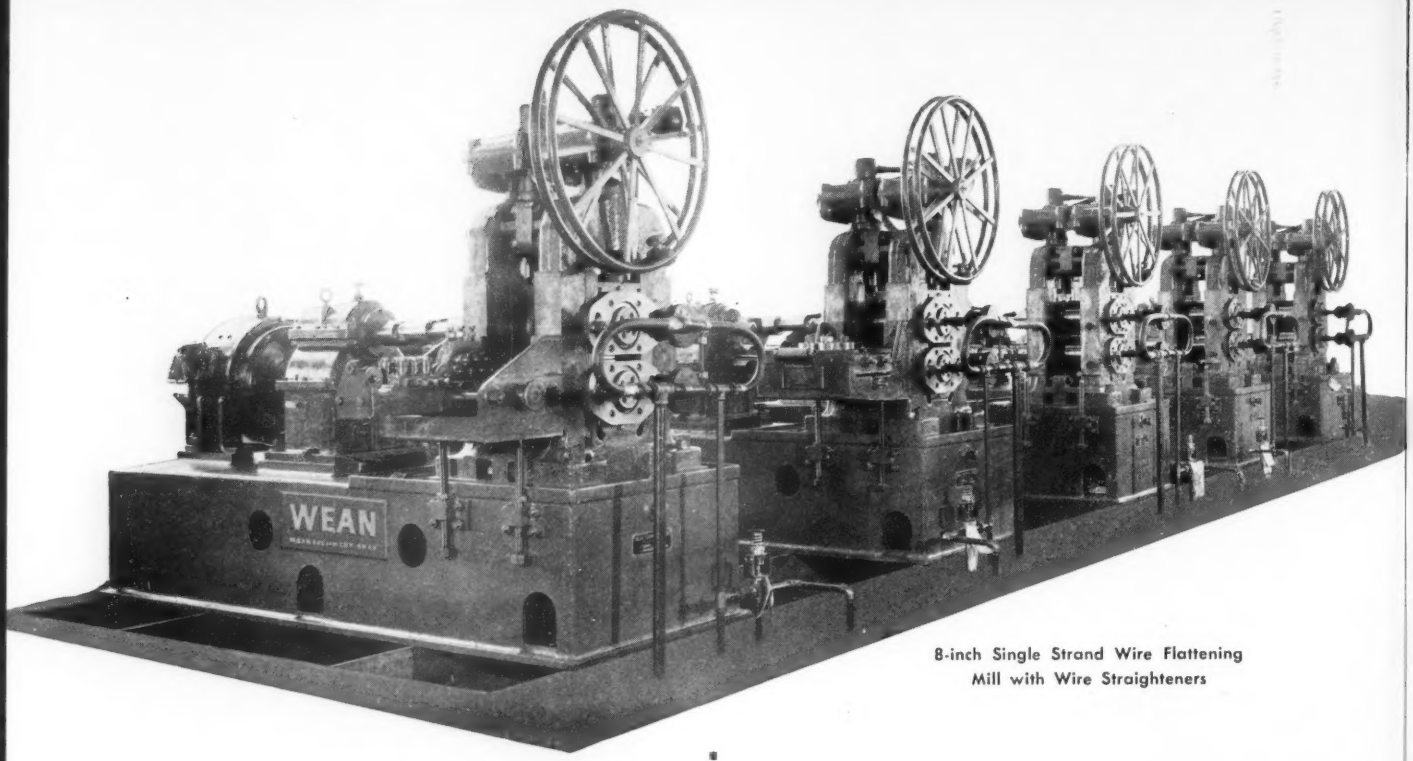
Wean



8-inch Single Strand Wire Flattening Mill with Wire Straighteners

THE WEAN EQUIPMENT CORPORATION are recognized as specialists in high-efficiency narrow strip, wire mill and straightening equipment.

COLD ROLLING MACHINERY

For 36" Wide Material and Narrower

MILLS - REELS - SLITTERS - LEVELERS
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WIRE MILL EQUIPMENT

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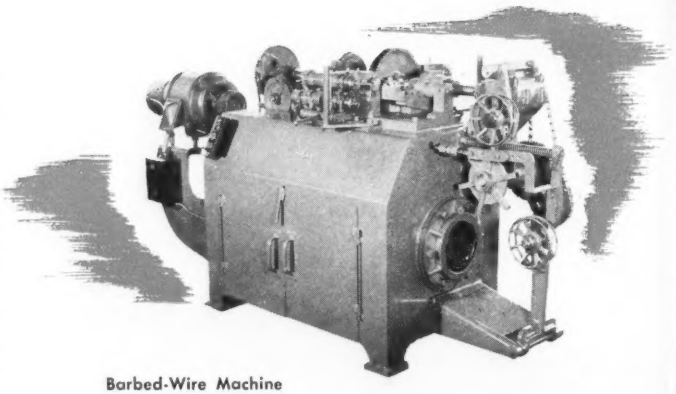
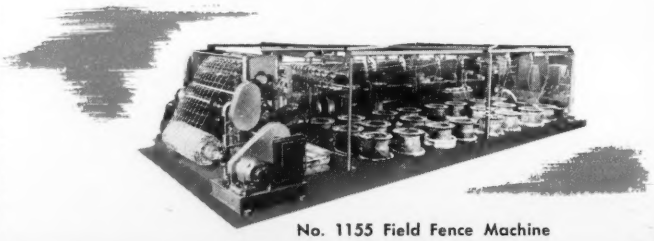


Barbed-Wire Machine



No. 1155 Field Fence Machine

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FAST DELIVERY

From standard stock this .004" #R1 die— for drawing fine steel wire

ANOTHER proof that Carboloy Cemented Carbide is your best bet for wire dies!

This new, higher-quality die—.004" #R1—is available to you through any of our many conveniently located Sales and Service Offices. Check these advantages that Carboloy offers you:

1. **FAST DELIVERY!** Every Carboloy Sales and Service Office keeps this new cored die in stock. A phone call will bring it to you in double-quick time!
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3. **LARGE OPENING!** The large front opening on .004" #R1 means easy accessibility for you. And that means more and better lubrication!
4. **SHORT APPROACH ANGLE!** .004" #R1 is easier to use. Because of the shorter approach angle, it requires less time for finishing, for refinishing and reservicing!

Every one of these advantages is important. Buy the die that offers them to you—Carboloy's .004" #R1 cored die for drawing fine steel wire.

For fast deliveries, lower prices, and higher quality, buy your wire dies from your nearest Carboloy Sales and Service Office. Conveniently located . . . in Pittsburgh, Detroit, Newark, Chicago, or Los Angeles.

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CEMENTED CARBIDE

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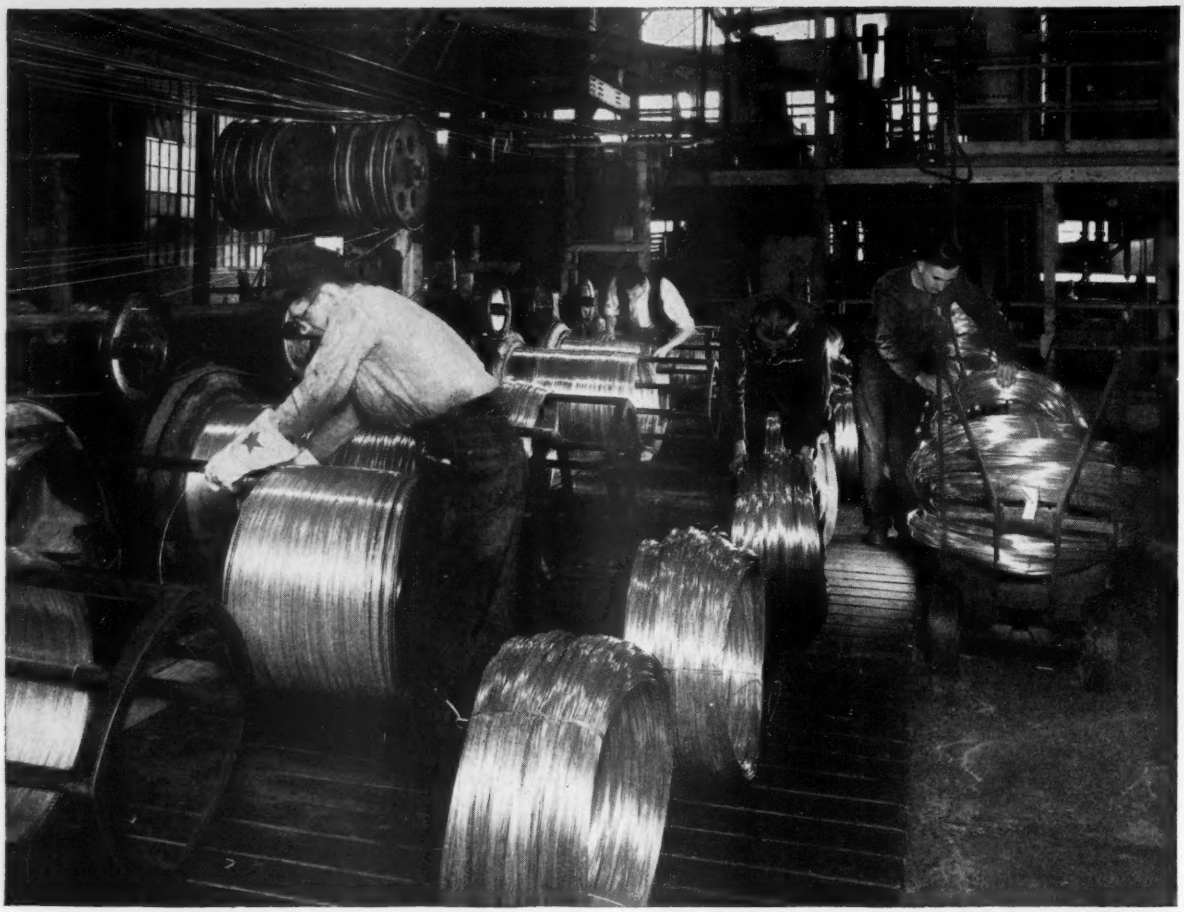

WIRE ... *for so many uses*

We make steel for so many different uses that the wire you need is probably a grade and quality we have furnished recently. Bethanized wire, bright wire, black annealed wire. Open-hearth steel, Bessemer steel. Low carbon, high carbon, and alloy analyses. Soft wire or hard, stiff or ductile. Wire for coiled upholstery springs, cold-headed products, for welding rod, chains, rope, screws, bolts, hairpins, buckles, handles, nutcrackers, steel wool.

Perhaps you're trying to cut down your costs, improve wire performance, or develop new products. Whatever your plans may be, our technical men are ready to contribute their experience, to work with you in achieving the best possible results.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

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★ BETHLEHEM STEEL ★ **BETHLEHEM WIRE** ★

WIRE & WIRE PRODUCTS, Vol. 24, No. 5, May, 1949. Publication Office, at One Sherman Ave., Jersey City 7, N. J. Executive Office, 300 Main Street, Stamford, Conn. Published monthly by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Secy. and Treas. Subscription price: U. S. $5.00; Canada, $5.00 per year; 50 cents per copy; Foreign, $7.50 per year. Entered as second class matter, January 10, 1949, at the Post Office, Jersey City, N. J., under Act of March 3, 1879.

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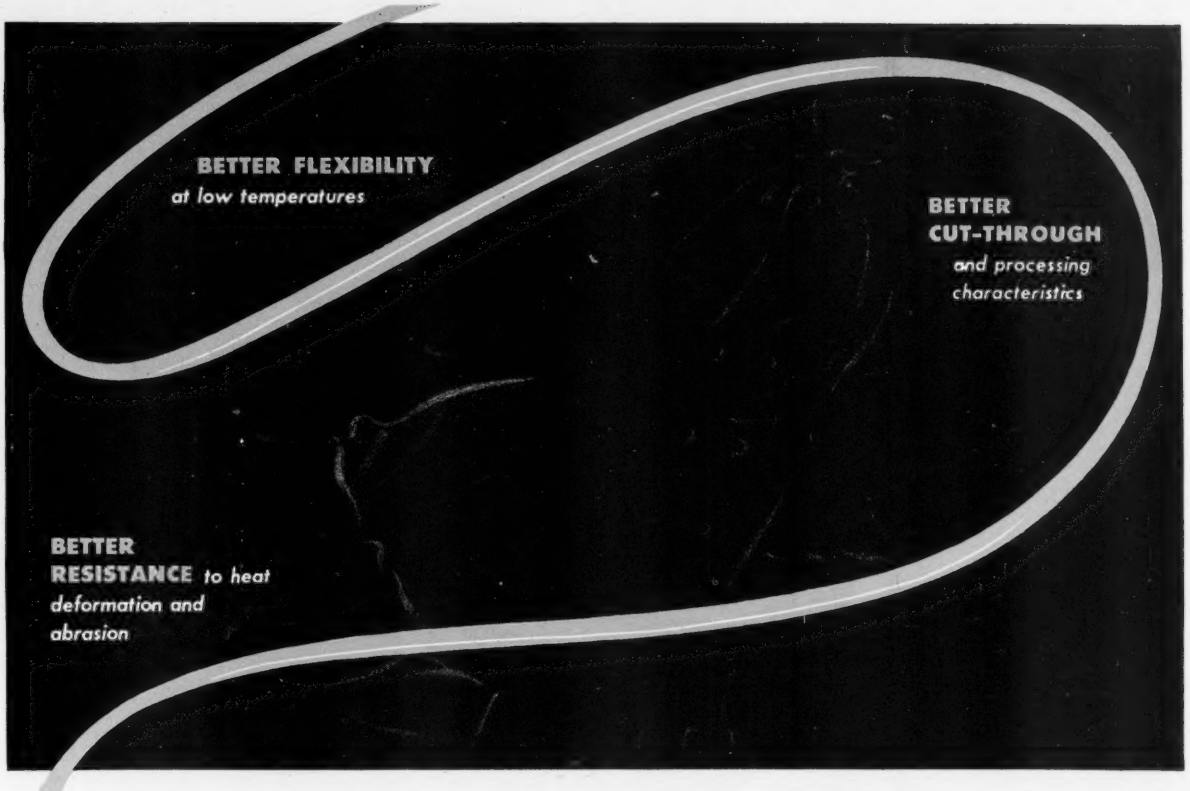

Here's why *better* coats and jackets are made from Marvinol®

WHEN it comes to coating wire, Marvinol VR-10, a superior vinyl resin, offers you these many advantages. Marvinol coats and jackets are dry, tough, abrasion resistant. They're flexible always . . . even at low temperatures. They resist shrinkage and heat deformation because Marvinol gives them superior dimensional stability.

Marvinol plastics withstand the destructive forces of light, aging, oils, acids. They're waterproof, tear-resistant with better cut-through.

In processing, Marvinol can reduce your costs through time savings on pre-mix, Banbury and open mill stages. Marvinol offers possibilities for faster extrusion cycles.

If you do not do your own compounding, let us show you how you can save money by performing this stage right in your own plant.

The Glenn L. Martin Company makes and sells Marvinol vinyl resin as a raw material to processors. It compounds and fabricates *only* in modern customer service laboratories for *your* benefit. So if you *make* coats and jackets for wire and want information . . . or if you *use* coated wire and want the name of someone now coating wire with Marvinol, write to Chemicals Div., Dept. W-5, The Glenn L. Martin Company, Baltimore 3, Maryland.

MANUFACTURERS OF: Dependable Martin 2-0-2 airliners • Advanced military aircraft • Revolutionary rockets and missiles • Electronic fire control systems • Versatile Marvinol resins (Martin Chemicals Division) • **DEVELOPERS OF:** Mareng fuel tanks (licensed to U. S. Rubber Co.) • Stratovision aerial re-broadcasting (in conjunction with Westinghouse Electric Corp.) • Honeycomb construction material (licensed to U. S. Plywood Corp.) • New type hydraulic automotive and aircraft brake • Permanent fabric flameproofing • **LEADERS IN RESEARCH** to guard the peace and build better living in many far-reaching fields.

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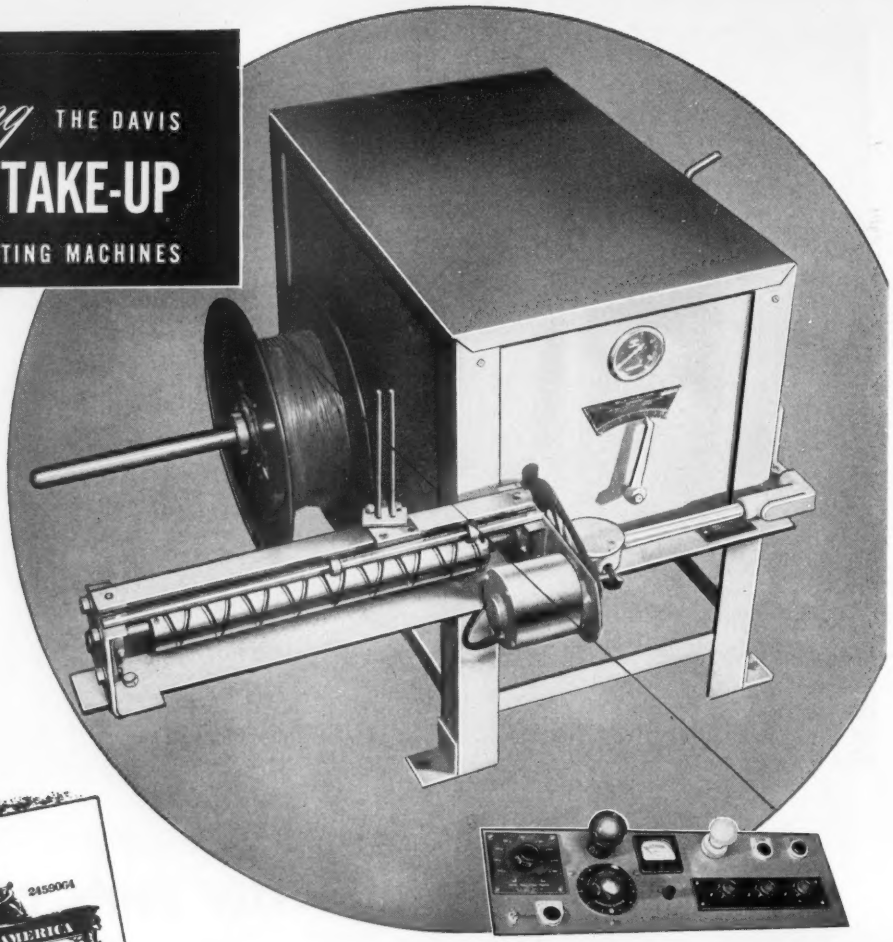
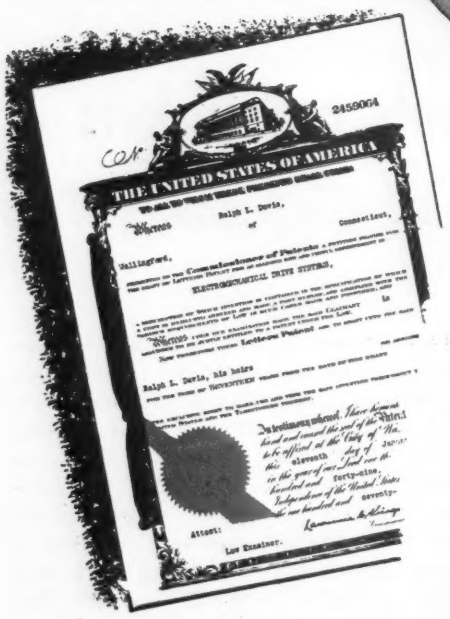
Introducing THE DAVIS

EXTRUDER TAKE-UP

FOR PLASTIC INSULATING MACHINES



Combination Control & Sparker Panel



2459064

THE UNITED STATES OF AMERICA

Ralph L. Davis,

of Connecticut,

Wallingford,

ELECTROMECHANICAL DRIVE SYSTEMS,

Ralph L. Davis, his heirs

Attest:

Law Examiner.

EXCERPTS FROM U. S. PATENT 2459064

- A simplified, inexpensive electromechanical drive system for the reeling of wire at constant and predetermined speeds to suit the size of wire while in operation. . .
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- The apparatus utilizes a polyphase induction motor which is energized from a polyphase power source through impedance elements in each phase — and reels wire at constant tension over extremely wide ranges in reeling diameter.

The Davis Extruder Take-Up is now in successful operation in some of America's most famous research laboratories. Names upon request.

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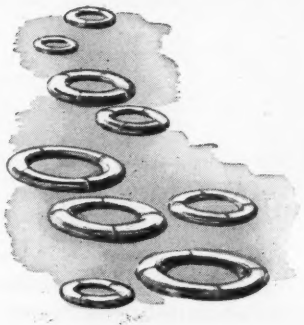
GETTING the *right* size of wire coil is no small matter when it comes to meeting production schedules . . . when it means the difference between a smooth-running operation and a cumbersome one. That's why Chase makes it their business to *supply* you with the coil size best adapted to *your* needs.

It's another example of the extent of Chase service. Add to this the fact that Chase quality is unparalleled in the industry, that Chase regularly makes wire in 22 different alloys to suit your every need . . . and you can see the advantages of dealing with the nation's largest network of brass and copper warehouses and offices.



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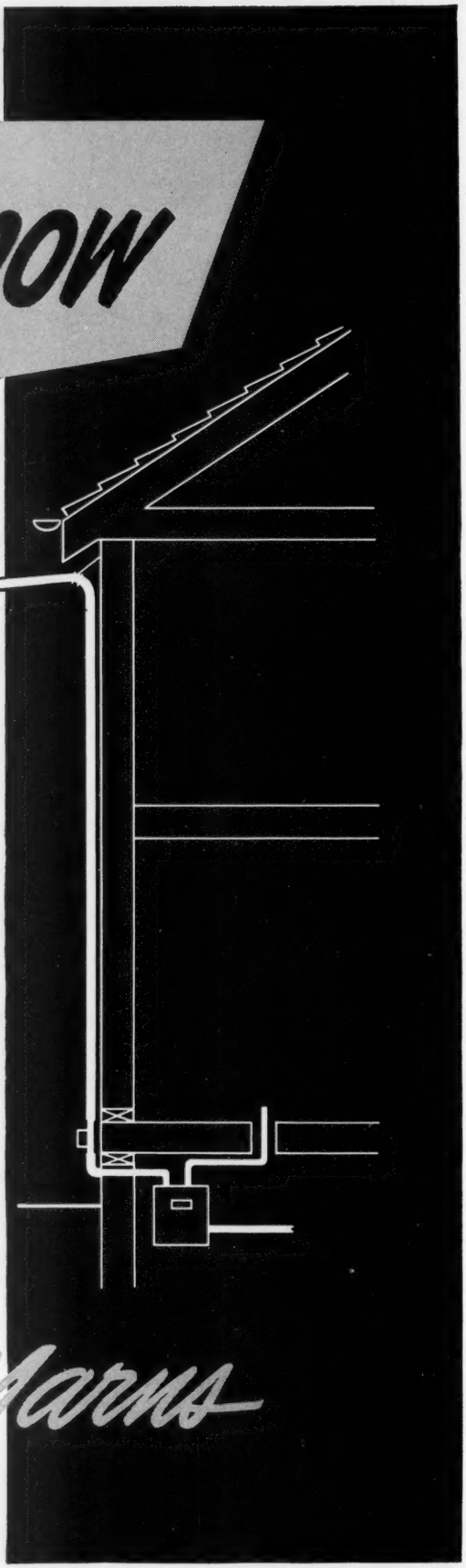

...why FIBERGLAS* 150's YARNS are used as outer braid of service entrance and service drop cables?

- Permanent—will not rot
- Low cost
- Will not absorb moisture
- Light weight
- Will not burn

For complete information about Fiberglas Yarns, for this and other electrical uses, write Textile Products Division, Owens-Corning Fiberglas Corporation, Dept. 875, 16 East 56th Street, New York 22, New York. Branches in principal cities. In Canada: Fiberglas Canada Ltd., Toronto, Ont.

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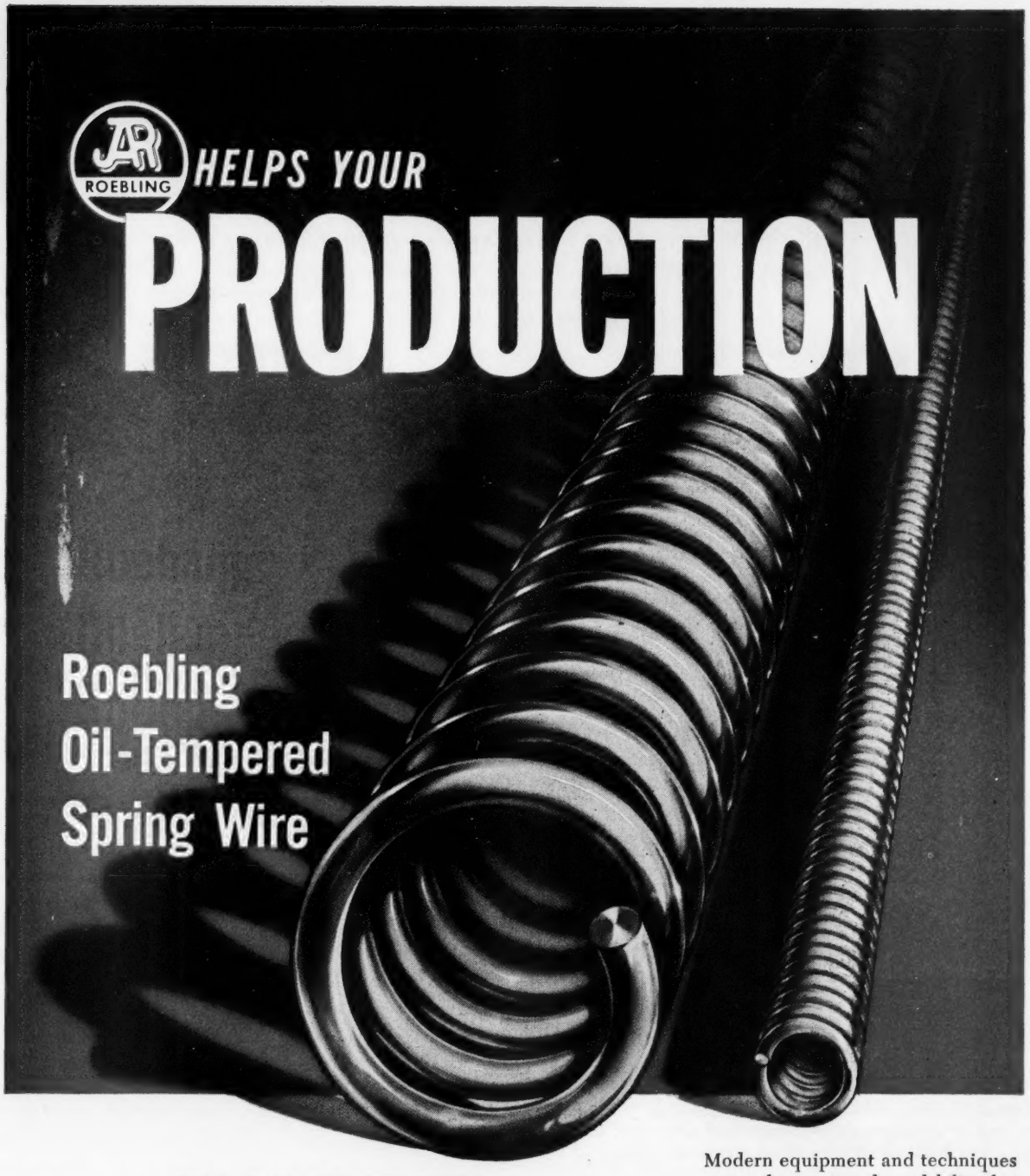

YOU CAN GET IT NOW!

YOU'LL CUT DOWN machine stoppages and minimize rejects with Roebling Oil-Tempered Spring Wire. This wire is a *quality* product. Every inch is identical in gauge and finish... uniformly up to snuff in mechanical and metallurgical properties.

Roebling Oil-Tempered Spring Wire is available now. Roebling has developed one of the largest wire mills in the country for making specialty wires. From making the steel to the finished product, every manufacturing phase is performed in Roebling's own plants. Modern equipment and techniques assure the constant dependability that has earned Roebling a century of confidence.

Your Roebling Field Man will gladly help you choose the best wire—round, flat or shaped—for utmost efficiency and economy in your products. John A. Roebling's Sons Company, Trenton 2, New Jersey.

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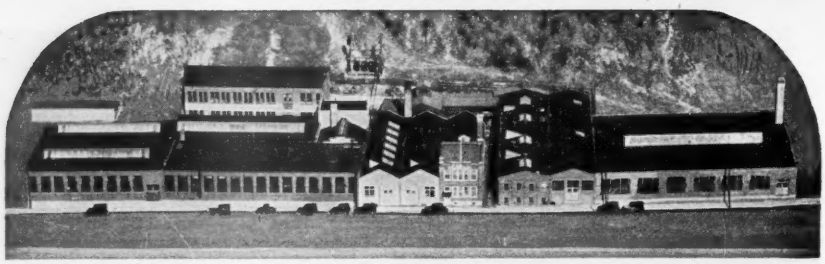
☆ *A CENTURY OF CONFIDENCE* ☆

HUDCO



HUDSON WIRE CO. PLANT AT OSSINING, N. Y.

This plant is one of the most up-to-date and completely equipped plants in the world for the production of "HUDCO" fine wires in all metals.

ESTABLISHED IN 1902

HUDCO

WIRES FOR METAL SPRAYING

Pure lead, Lead Alloy, Pure Zinc, Zinc Alloy, Copper, Tin, High Brass, Low Brass, Solder Wire. High Conductivity, Electric Wire. Cadmium, Nickel Silver, Aluminum, Monel Metal, Prosphor Bronze, Pure Nickel, Commercial Bronze, Brush Wires, Crimp and Straight, Brass, Steel, Nickel Silver, Copper and Prosphor Bronze.

HUDCO

FINE BARE WIRES

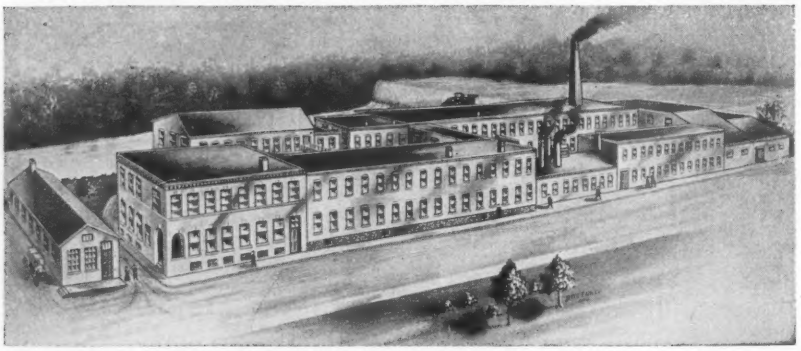
High Brass, Low Brass, Zinc 99.99+ and High Tensile Zinc, Commercial Bronze, Phosphor Bronze, Pure Tin, Lead, Antimonial Lead, Tinsel Lahns, Silver Plated Copper, False Gold and Copper. Cadmium, Nickel Silver Silver Plated Copper, False Gold and Special Brass and Bronze Alloys to Specifications, Metallic Fibre for Packing Purposes, Copper Bronze, Zinc, Lead and Aluminum.

"HUDCO" specially processed Copper Wire for enamelling purposes is drawn from selected Copper, insuring the maximum conductivity. This is but one example of the use of the most advanced and approved materials and methods in our processing.

BETTER WIRE AT LOWER COST

Send Us Your Specifications and Let Us Quote Prices

HUDSON WIRE COMPANY • OSSINING, N. Y.



Winsted Division of HUDSON WIRE CO. at Winsted, Conn., modern and completely equipped enamelled wire plant for LEAKPROOF ENAMELLED WIRE and all standard and special coverings.

WINCO

"WINCO" enamelled wire is drawn from special selected copper, assuring perfect enamelling. All wire tested before shipment.

"WINCO" enamelled wire is available in all standard and special coverings made to meet exacting requirements.

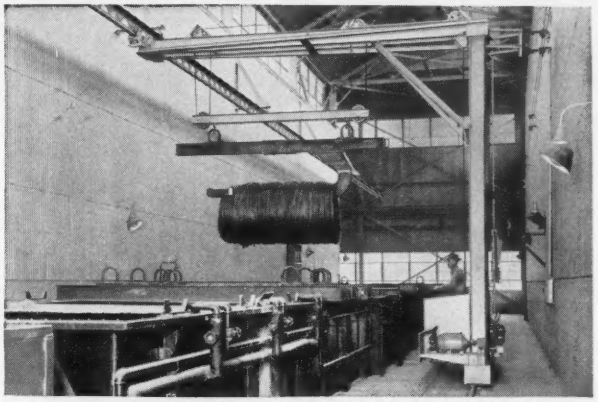
Samples of LEAKPROOF and other enamelled wires sent on request

WINSTED DIVISION OF HUDSON WIRE COMPANY

WINSTED, CONN.

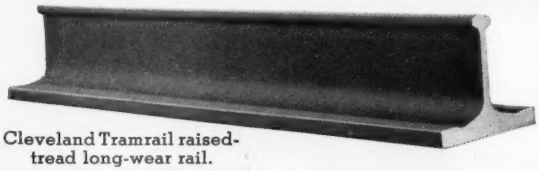
MATERIALS HANDLING IN THE WIRE INDUSTRY

Many wire and wire products plants are enjoying the numerous advantages possible with Cleveland Tramrail. They are speeding production and lowering costs by using larger production units, eliminating rehandling and reducing machine "shut-down" time. They are using overhead space to save floor space. They are promoting safety. In many instances they are eliminating need of plant expansion by installing Cleveland Tramrail.



Cleveland Tramrail cleaning house gantry cranes boost production, cut costs sharply and greatly aid health and safety conditions.

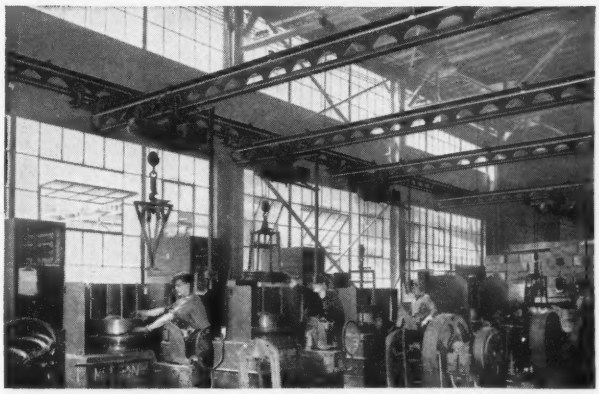
STANDARD ITEMS EASILY COMBINED TO HANDLE MATERIALS OF ANY KIND



Cleveland Tramrail raised-tread long-wear rail.

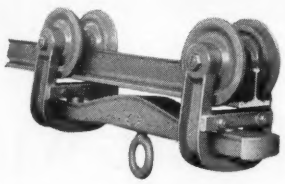
Cleveland Tramrail consists of standard items such as rail, switches, carriers, cranes, hoists, grabs, etc., which can be combined in a thousand-fold ways to serve nearly every materials handling requirement.

Cleveland Tramrail Archbeam in seven sizes for various loads and conditions.



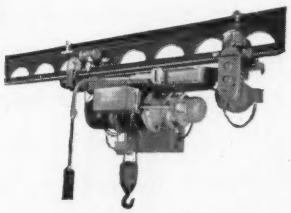
Providing each drawing block with an individual Cleveland Tramrail stripping crane speeds production and brings about sizable savings. Hernia injuries from heavy liftings are eliminated.

30,000 INSTALLATIONS



Hand propelled carrier built for long life and easy operation. Wheels have hardened tread and flange; bearings are double race type.

Backed by experience with 30,000 installations in industries of all types, Cleveland Tramrail representatives are in exceptionally good position to serve you. They will gladly advise, survey your plant, make layout or prepare quotation without obligation.



Motor-driven carrier with electric hoist. One of many types built by Cleveland Tramrail.

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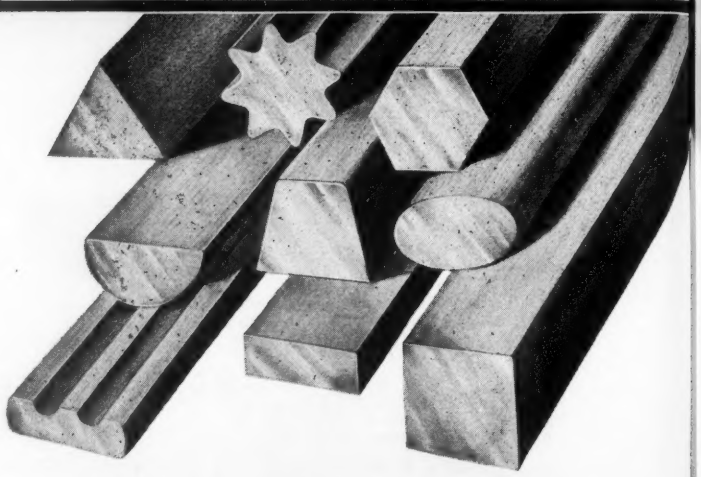
PRODUCT-PROVED WIRE

Hundreds of leading manufacturers demonstrate a strong "repeat" preference for Continental wire. Their own products have proved the worth of this wire. Their own experience has convinced them that Continental has the wire that wins customer friends. Whether your need is for a rust-resistant wire that can stand up under difficult forming operations . . . or for a shaped wire to provide smarter-looking, longer-lasting trim—whatever the nature of your own product—Continental wire can help you build a better, more profitable product. Continental wire is uniform in temper, uniform in coating. It is made to fit specific manufacturing and fabricating requirements. Write Continental at Kokomo. Tell us about your wire needs.



CONTINENTAL WIRE

Shaped to Fit Your Special Needs

Continental special shaped wire has product-proved "sales appeal." It is helping boost the market appeal of many products. The things you make may have one or more parts which can be "shape-engineered" from wire to do a better job . . . with added profit for you. Continental's handy booklet of helpful wire information will be sent you free on request.

CONTINENTAL STEEL

CONTINENTAL STEEL CORPORATION

GENERAL OFFICES • KOKOMO, INDIANA

PRODUCERS OF *Manufacturer's Wire* in many sizes, shapes, tempers and finishes, including Galvanized, KOKOTE, Flame-Sealed, Coppered, Tinned, Annealed, Liquor Finished, Bright, Lead Coated, and special wire. ALSO, Coated and Uncoated Steel Sheets, Nails, Continental Chain Link Fence, and other products.

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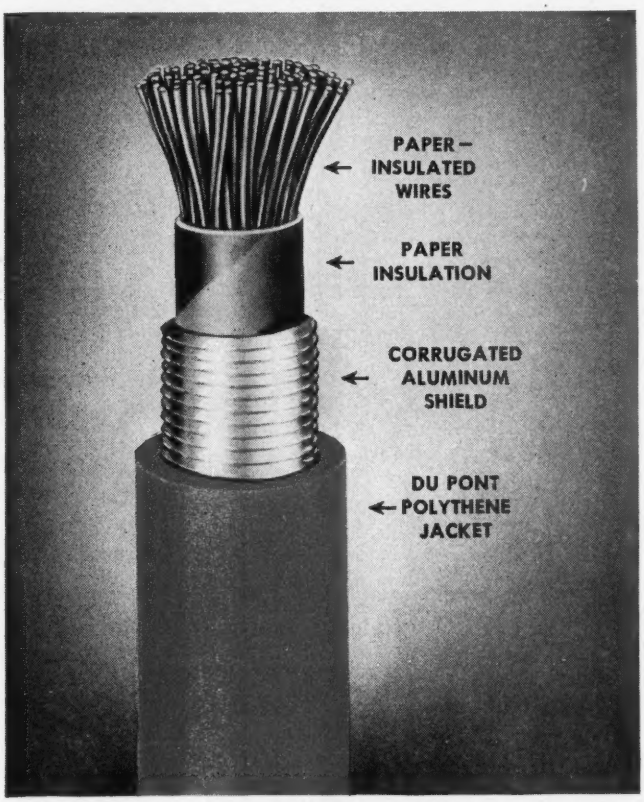
DU PONT POLYTHENE PLASTIC HELPS TELEPHONE ENGINEERS SOLVE TOUGH PROBLEM

New Jacket of Polythene and Aluminum is used as Shield on Telephone Cable

The shortage of lead for telephone cable sheathing was solved recently, after some years of research, by engineers of Bell Telephone Laboratories and Western Electric. They found an economical answer in a jacket of a new plastic, Du Pont polythene . . . extruded over an aluminum shield.

Polythene was chosen because of its mechanical properties, resistance to many chemicals, resistance to weathering when properly compounded, and ease of extrusion. And the moisture-resistance of the polythene-aluminum combination is excellent.

NEW WESTERN ELECTRIC CABLE CONSTRUCTION



"Alpeth" cable shown above, a joint development of Bell Telephone Laboratories and Western Electric Company, is now being manufactured by Western Electric.

ELECTRICAL ENGINEERS FINDING MANY NEW USES FOR DU PONT POLYTHENE PLASTIC

The use of polythene in telephone cables follows its widely accepted use in many other types of electrical equipment. In one current application, polythene is used to mold the potential coil to the electromagnet core of a new watt-hour meter. Polythene provides greater insulation strength, reliability . . . and extra-long life for this potential coil.

Polythene molding powders may be injection- or compression-molded . . . extruded as sheeting, tubing, or wire-covering. They are available in a range of colors. The demand for polythene still exceeds the supply, but continuing increases in production are being pushed to meet this situation.

Facts about properties of Du Pont polythene and examples of current use may be obtained by writing E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Empire State Building, 350 Fifth Avenue, New York 1, New York; 7 South Dearborn Street, Chicago 3, Illinois; or 845 East 60th Street, Los Angeles 1, California.

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Plastics
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. . . THROUGH CHEMISTRY

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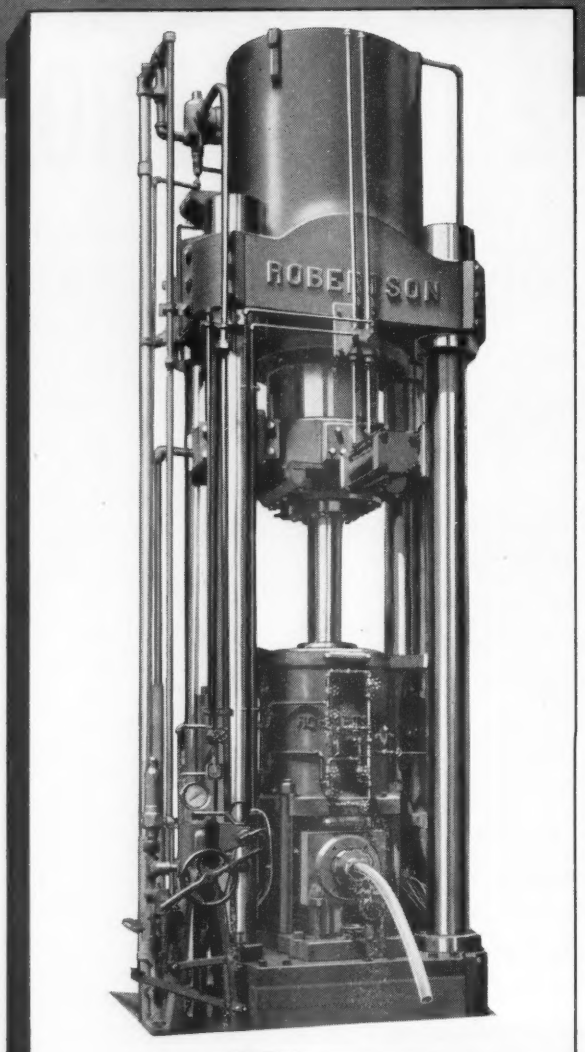

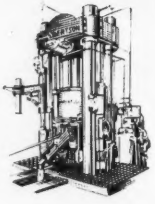

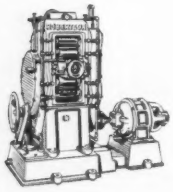

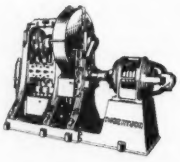

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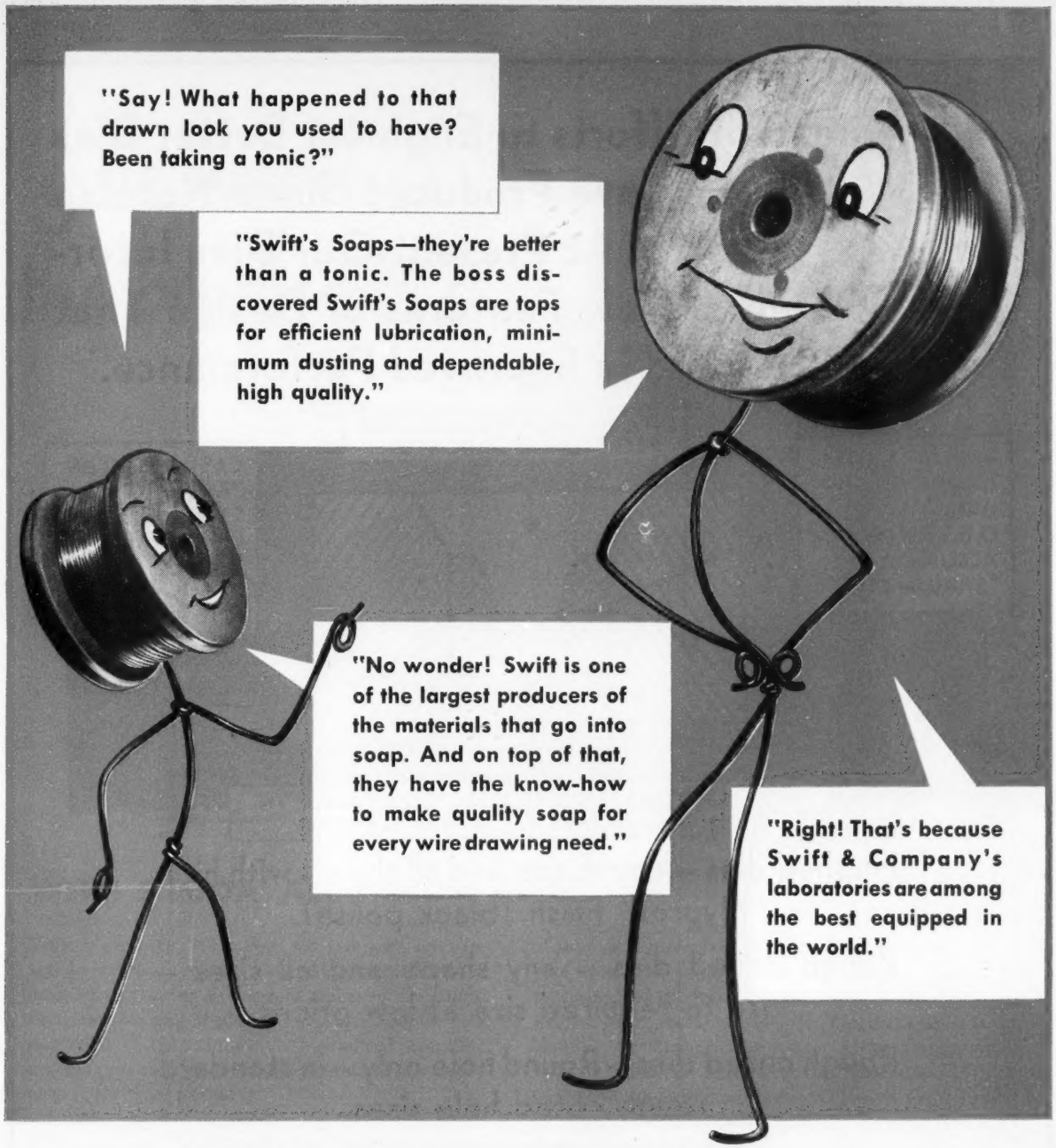
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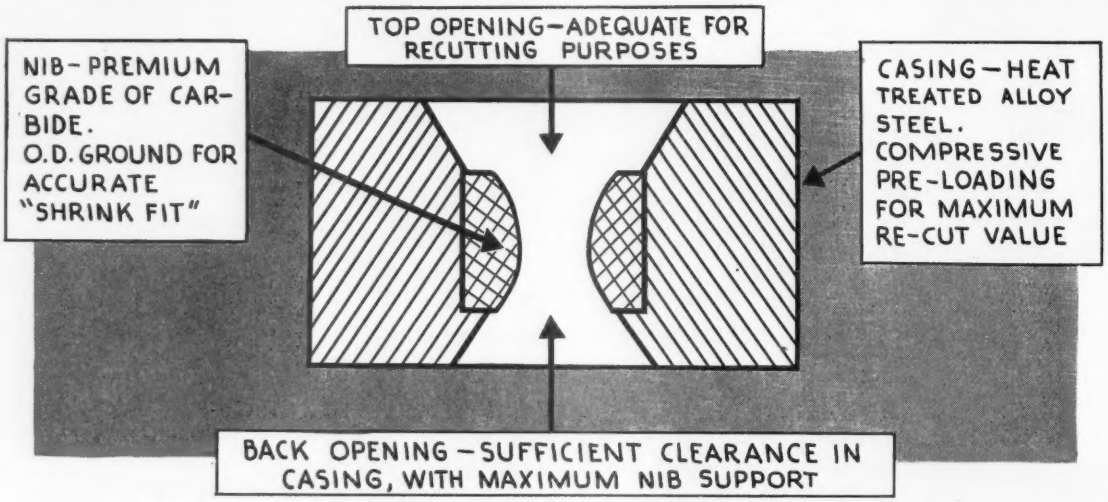
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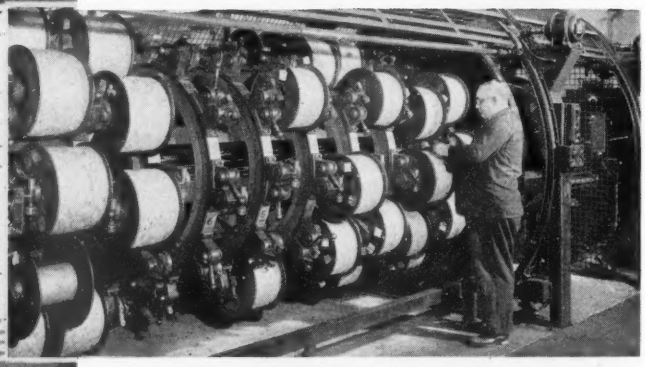

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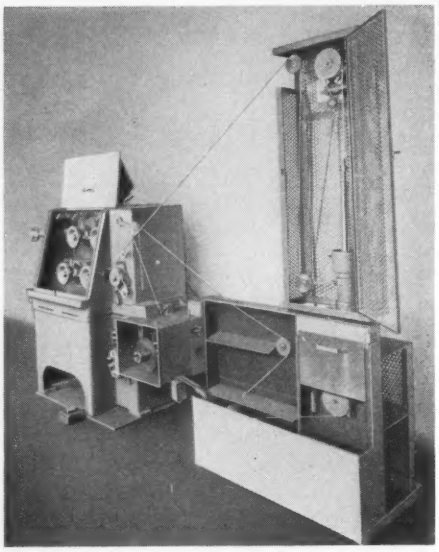

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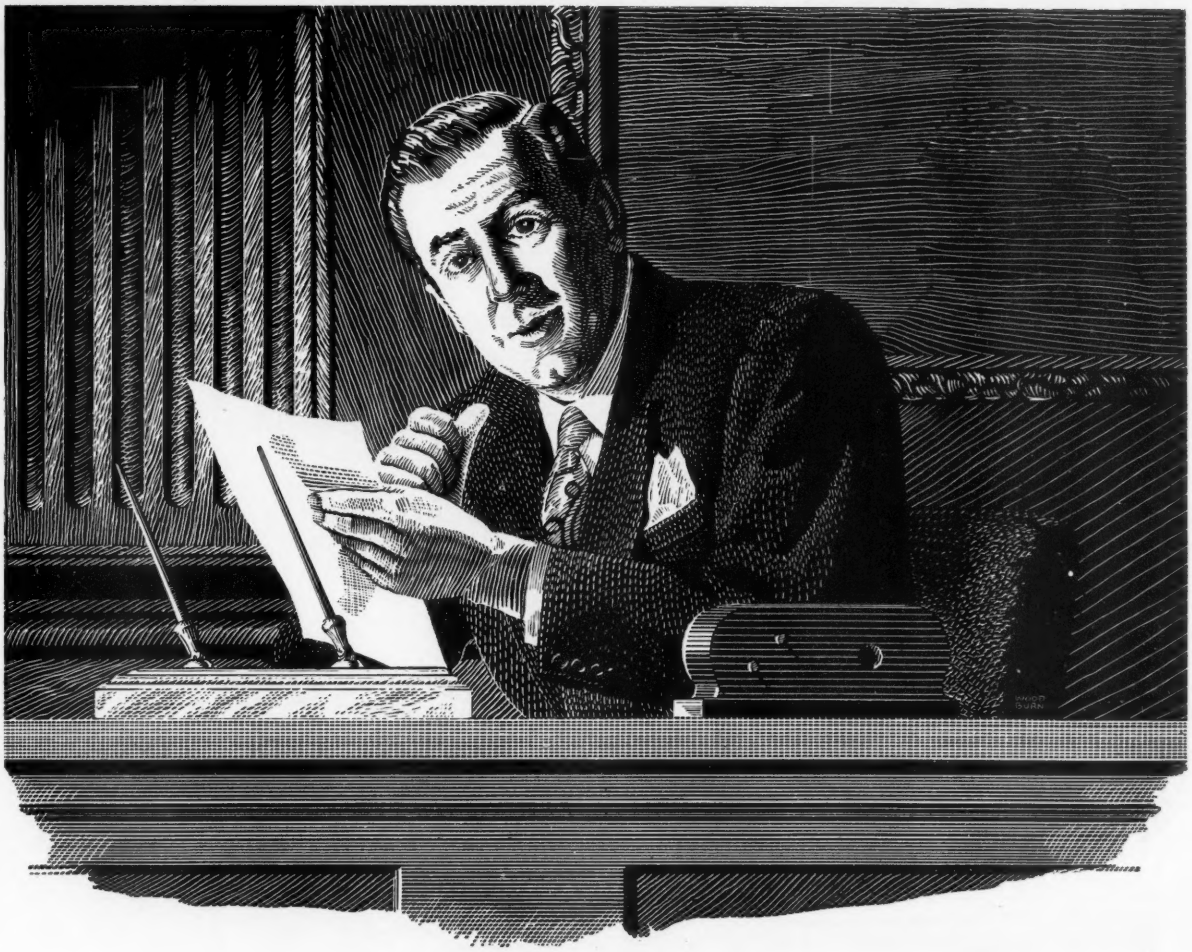

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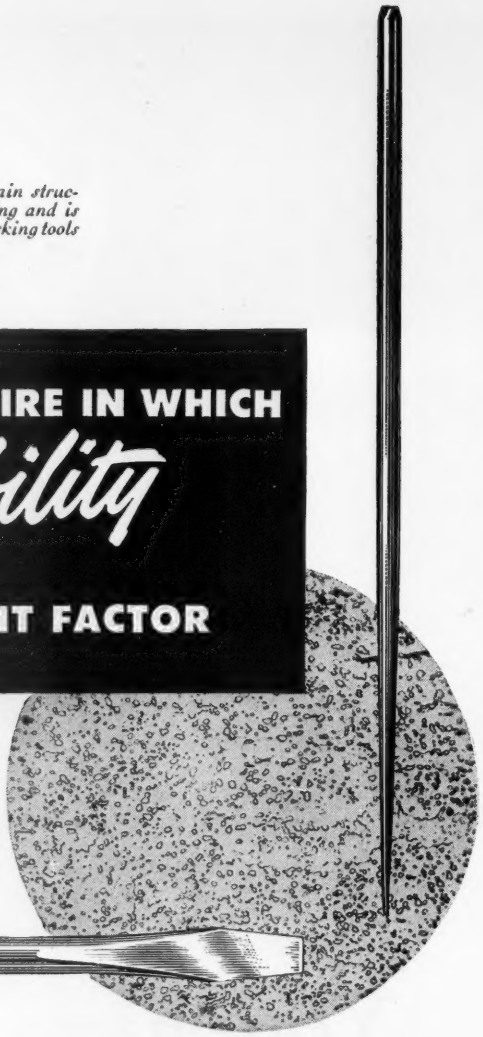

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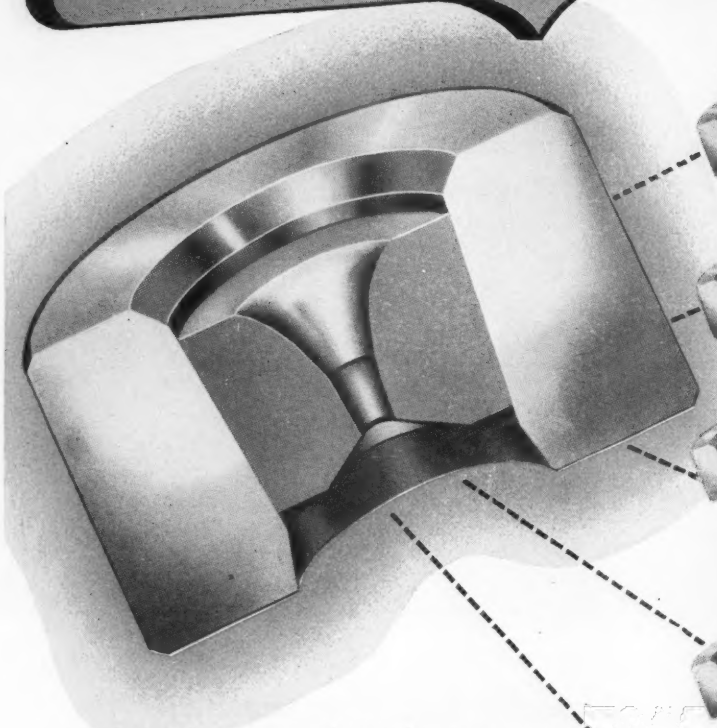

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The Wire Outlook

Prices continue a slow, but steady recession, embracing more and more products each week. This movement started with consumer goods and has now spread to steel and durable goods circles.

On many products the "shake-out" is healthy. On others it may mean financial embarrassment. In considering what is good and what is bad, it is important to keep in mind the difference between those prices that rose to unnatural levels because of critical scarcities and those that were forced up by high wages and other basic cost increases. Large recessions can be expected in the former and small in the latter. Prices cannot drop below operating costs plus profit without endangering industrial stability. Items like lead, tin, zinc, scrap, etc., are being and should be brought back to saner levels. A basic metal like steel, that advanced relatively moderately as forced by increasing costs, can and is falling only slightly in keeping with reductions in the costs of supplies.

The danger in any recession period is not necessarily declining prices, but the attitude of mind that it begets. Our economists currently are advising industrialists to keep a sharp eye on the crucial weeks ahead. If the advice were followed literally, little buying would be done, which in turn would induce greater business inactivity. "Disinflation," as Washington calls it, can be now, as it usually is, very largely psychological. For this reason, it is important to continue to place orders for normal requirements and "keep the ball rolling." That this is being done is indicated by a number of reports of better business and increasing payrolls. As adjustments have progressed to the present, they may be said to be desirable and the means by which we shall avoid a sudden and devastating crash later on.

While steel production continues at record levels, the day of a real balance between supply and demand is now not looked for until the latter months of the year. Military requirements are taking more and more. The Office of Industry Cooperation has requested cuts in the voluntary allocations of steel by as much as 25% starting in June, but state that this will not be as serious as it might appear, as many steel users are getting more than they need. Offsetting this is a reduction in steel exports due to the dollar shortage abroad. Some steel men believe that voluntary allocations will gradually fade from the picture, however.

Duplicated orders and orders for more than normal requirements are almost a thing of the past. Better assurance of regular deliveries of steel is enabling both producers and fabricators to gauge their needs accurately. Gray market operations have ceased to exist and scrap, by the first of April, had fallen from $39.00 at the first of the year to $21.00 for No. 1 heavy melting scrap in New York. This is within $6.00 of the old O. P. A. ceiling. Those steel companies who had been accepting orders at higher than market prices, have all dropped to competitive levels. All these factors indicate clearly that the sellers' market is over and buyers are beginning to come into their own again.

There has been a downtrend in the demand for manufacturers' wire in recent months, although merchant wire is holding strong. The high wire production of recent months has tended to fill inventories, reducing much of the pressure on mills and most buyers, in the face of recent price reductions, may be said to be inventory conscious. They are also becoming more fussy about specifications and a number of instances are on record where off-color wire or off-heat rods have been rejected. Semi-finished rod supply has not yet improved materially, however. Automotive wire has softened, but holds at a high level of demand. Music and rope wire sales have taken an upswing and wire for fencing and nails may soon be in short supply as Spring farm projects and building move ahead.

There is this to keep in mind about the wire industry. Its types, sizes and uses are so many and varied, that it is a depression-resistant industry, although it would be foolish to say that its general prosperity is not tied in closely with the fortunes of the country.

Everyone wants prices to be in reasonable adjustment to values, but let's not hold off on needed purchases of machinery, equipment and supplies while waiting to see what's going to happen.

—from the Editor's Desk

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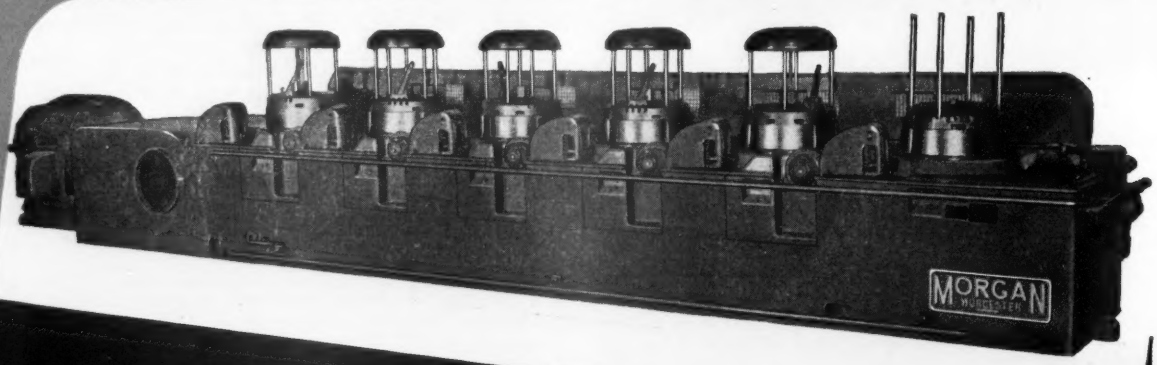

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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 24 MAY, 1949 No. 5

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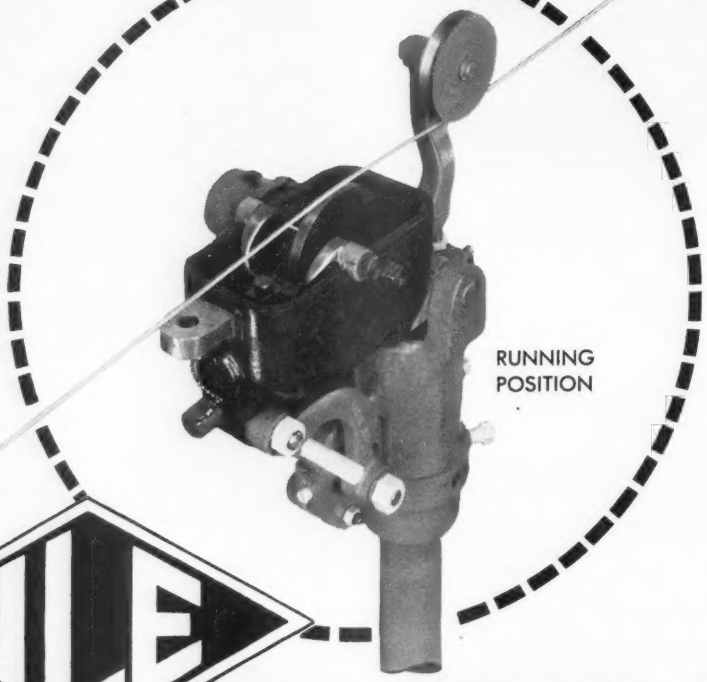

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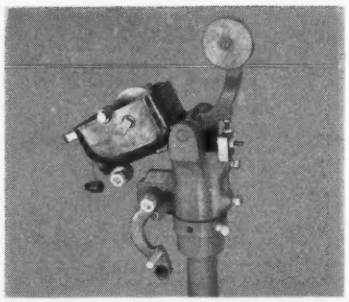

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WIRE
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A monthly publication devoted to the production of Wire, Rod and Strip.
DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 24 MAY, 1949 No. 5

Wire Drawing Lubricants

By Charles P. Orr, President
Standard Industrial Compounds
Chicago, Illinois

A discussion of wire drawing lubricants, a paper presented before the Canadian Meeting of the Wire Association at Montreal in April, 1949.

IT is rather difficult for a person in my position to present anything on wire drawing lubricants without at least being accused of being biased and it is indeed rather hard to present what we have learned, as necessarily most of our experience has to do with our own lubricants. But in this work we are also able to observe and learn what other people are doing and we will, to the best of our ability, present what we have observed in the different mills over the country as we see them and then whoever disagrees with us will have an opportunity to say so and they can tear us apart and throw us to the dogs.

★ ★ ★

IN the first place, we do not believe that lubrication as it is commonly referred to, is the right word or term to be used when referring to wire drawing, for it is not lubrication in the strict sense of the word, such as would be used, say, for the lubrication of bearings or motors. If this were the case simply something like lard oil or a good grade of mineral oil could be used as in the strictest sense, it would be a better lubricant than soap, but would not do the job.

★ ★ ★

AS an example, you desire to draw, one hole, a clean and bright wire; if you used a good soap, that was a good lubricant, on this, the wire would be neither bright nor clean. You have to use something that is really not a good lubricant, that will break down and not carry thru, so that there is little if anything left on the wire. Brightness is caused by friction and without the lubricant breaking down to some extent, you would not get this friction and therefore the wire would be neither clean or bright.

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YET on multiple drawing at high speeds it is necessary that the lubricant put on a coating that will stay with the wire and not break down on the successive drafts. Therefore it is a coating to protect rather than a medium of lubrication. We know of a case where they are drawing low carbon rods at a speed of 3200 ft. per minute. with only a 4% lime on them and with soap or compound only in the first die box. This cannot be done with an ordinary soap, which from the pure lubricating angle would be much better. We recently had the occasion to draw some high carbon wire, six holes at high speed when it should be drawn in seven holes. For this job we had to substitute old used soap and it still had to be cut back with lime to get it to run. It simply would not run with a rich and higher lubricating soap. There is required, of course, some lubricity as it is commonly known, so as not to develop unnecessary friction, but to us, it appears that the most important element is the **protective quality** of the lubricant. In this connection, we would like a different word than lubrication and such a word as **lubricoating** occurs to us, but we doubt if Webster will adopt this word in the near future, so for want of a better word, we will call it lubrication.

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WHEN you speak of wire drawing lubricants, you just have to start in the cleaning house with the preparation of the wire to be drawn, for no lubricant is good enough to overcome the effects of poor cleaning. And also to our mind the job of the cleaning house is not just to clean the scale from the rods, but also to be prepared to clean the wire for further processing such as electro plating or coating with copper, zinc etc. We have had complaints that a certain lubricant left too much coat-

ing on the wire when finished and that they were unable to clean the wire for coating afterward. In other words the lubricant was too good, it held up too well, so they change the lubricant and sacrifice the drawing. This, we believe, is shifting the problem of the cleaning house onto the wire drawing department and this should not be done until all the possibilities of the cleaning house have been explored. Something like another dip, perhaps the addition of a wetting agent in the acid or a combination of two acids, might enable them to get the wire clean and they would not have to sacrifice the drawing efficiency.

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FOR the drawing of rods or wire a coating of some sort or another is required. This to neutralize the carryover acid and also to provide a carry-agent for the lubricant and the additional protective coating we spoke of above.

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FOR years lime has been used and in spite of its drawbacks it has not done such a bad job, but there has been a lot of interest lately in lime substitutes. Lime is not a good neutralizer and tends for a dirty mill etc. Heavy lime is difficult to dry and if not dried, rust will form underneath. But lime is cheap. All substitutes have a strike on them to begin with; they are all more expensive, so it is necessary for them to show other results, such as better drawing, better die costs or increased production. In cases where lime may be a detriment to the final finish, cost does not enter into it. But perhaps 90% of the wire drawn is nail, fence, rope, spring etc. and on this it is a factor. As a rather smart little operator said to me "You certainly cannot justify a great deal of extra cost just to get rid of a couple of old sweepers, you don't know what in the H - - - to do with anyway." I was giving my song and dance about a certain coating, to a Purchasing Agent who is also an Engineer with his Company, and evidently what I had to say, either interested him or amused him, I don't know which, but he took me in to see the Manager. I went over my story, perhaps embellishing it a little for his benefit and when I had finished, he turned to me and said, "Mr. Orr, this is all very interesting and perhaps enlightening, but when you have something as cheap as lime come in and see me." I have seen him since, **Thru The Door.**

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THERE are various types of lime substitutes and here is where, as I mentioned before, it is hard to tell about them without stepping on someone's toes, but we feel that if anyone deserves to market any of these products, they should be strong enough to stand up and proclaim the value of their product and to have sufficient confidence in their product to explain or demonstrate its worth. We do not see how it is possible to discuss lubrication without going into these coatings and we do not feel that the mere mention of them is enough. So we will discuss the ones we know. After all it is our opinion only, and we have been wrong.

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Alkaline Type

THE most commonly used, we will call the **alkaline type.** These are straight alkalis or a combination of alkalis. They are sold under trade names or they are alkalis bought direct from the manufacturer. As to the merits of either, it is not in our province to discuss or argue. As Cleopatra said to Mark Anthony when he was talking a great deal to her **"I am not prone to argue".** We believe it is up to the people who make these products to discuss their merits. This type will definitely neutralize any carryover acid better than lime. It will eliminate baking entirely or will reduce the baking time considerably. It will also eliminate any lime of the wire if this is detrimental to its end use. Better die life is reported by many mills and better overall results. Less soap is used than with lime and you have a cleaner mill. You can get a bright, clean wire at times where you cannot with lime. In order to determine if this type of coating is better for your mill, we believe you will just have to try it.

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Acid Type

THEN there is the **acid type,** usually if not entirely phosphoric acid of different types and strengths. We can speak a little more freely about this type as we have such a coating and have had for sometime. So if we criticize this kind we are therefore criticizing ourselves. Some makers of this type recommend the use of lime over the coating but to our mind this is an objection, for if you are trying to eliminate lime, you are not doing it. As to its value under lime, I am not prepared to say. It will etch the wire to some extent, for which there is claimed a benefit in drawing. These coatings will not neutralize the acid carryover as will the alkalis, but they will counteract the effect of the acid if the wire is allowed to come in contact with the solution for a sufficient amount of time. That is, no rust will form, if the solution comes in contact with the wire for a sufficient time. It takes longer than it does for the alkalis to neutralize. If a bundle of wire is not opened up sufficiently so that some of the strands lie together, where the solution does not have the opportunity to really reach parts of the wire and if they do not dry rapidly, then we have experienced trouble, as there is some kind of hard substance formed, not rust but something with the same effect; it will pull out dies. But this coating has some good points also, we have on several occasions noted that on copper or liquor finished wire, for wet drawing, that this coating gave very good results, better than the alkaline one. This especially on high carbon wire.

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IN the days of steel dies most wire was sull coated and here again was the same old thing, a coating to protect the wire, but with the advent of carbide dies the tendency has been to get away from it, as being unnecessary. Sulling is hard to control, that is to get the same wet sull day after day. This may be due to humidity,

changes in water at different seasons, or something mechanical in the sull rack itself. Suffice to say, it is hard to control and can cause a lot of trouble. Yet we do know of mills that seem to be able to control their sull and the results obtained are very good, much better than they are able to get with lime and better than they could get with the alkaline coating without the sull. We could quote you figures on this.

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Synthetic Sull Coat

SO knowing the results obtained where the sull is controlled, it occurred to us, why not a sull be put on as a coating, a synthetic sull coat if you please, that would be just about the same day in and day out and could be controlled. This is now being done on a limited scale but there have had to be many changes made and there have been failures, but we firmly believe that it will work out satisfactorily and that it can be used at a comparatively low cost.

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Types of Lubricants

AS to the lubricants themselves, there are as you know a great many types and kinds. We are all familiar with the use of grease mixed with different proportions of lime, but less of this is being used. In these days of continuous high speed drawing, grease will not stand up as well as soap and for this work we have found that metallic soaps stand up better than do soda soaps. They are harder and tougher and their melting or softening point is higher. They will not break down as easily nor will they burn up as readily. Most of the metallic soaps are really just lime soaps but sometimes there is added other metallic substances such as lithopone, zinc-oxide, mica, talc etc. But it is a very moot question, how much of an advantage these are and we feel that in some kinds of soap, when used particularly on fine wire drawing, they will eventually build up in the dies and cause trouble. These pigments do not seem to go into the soap and really become a part of the soap as will lime and we greatly question that the same amount of lime added as a pigment would not be just as effective and perhaps more so, if the soap is not just right. Consider mica as an example, we take this as due to its slippery feel and shiny appearance, it is more apparent than some of the other pigments.

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Mica and Pigments

IF you watch such a soap, you will see the soap and mica dropping off after the first die, not as a composite thing but as two different substances and you will see the mica in pieces as large as one fourth of an inch long and an eighth of an inch wide and you will note it fluffing off after the second die in flakes and after the third die it appears to just be about all flaked off. And we believe that if there is any value in this type of soap it is in the soap itself and not on account of the mica added. And also if these pigments would remain on the wire until the finish, then you would have to be very careful as to just what you use as many of them are not soluble in either alkali or acid, and it would be impossible to clean them properly, for further processing or for coating. So it would appear that one should only use pigments on special jobs where you know what is going to be done with the wire. It is much safer to stay away from them if possible. Others may have different ideas about this, but we can only give you our experience. If some pigment seems desirable, we believe it should be incorporated into the coating rather than the soap. We have heard of mica being used in a coating and better results were claimed.

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Type of Fats

IT is also important to consider the type of fats used in the making of soap. There are certain types of fats used that when they are made into soap do not seem to have the ability to stay with the wire down thru the successive drafts but will fluff and burn off before it reaches the final draft. You may have noticed this on your machines, the amount of soap fluffing off after the first hole and by the time it is coming off the second, it is a dry black powder. By this time you have lost practically all the lubricating part of the soap and all you have left is the coating part caused by the burnt soap, yet you should have some of the lubricating part also. On other soaps you will notice practically nothing coming off the wire after the first hole and very little after the second but it does start after the third. If you will examine this you will find that there is still considerable of the lubricating value left and we have actually gathered this up, cleaned out the first die box substituted this, drew wire and drew it all right too. We would not however suggest that you have your men do this, as after all, we do have to live.

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SO the kind and quality of the fats used is important as the soaps made are not going to be any better than the fats used. Just as you cannot make high grade motor oil from inferior crude oils, you cannot make a high grade soap from inferior fats. You cannot, for instance, take collected grease from a packing house, containing all kinds of impurities, and make as good a soap as you could from a practically pure hydrogenated fat. This hydrogenation raises the titre of the fat, raises the melting or softening point of the soap to where it just is a tougher soap and will take a lot more punishment. We will go on record to say that for continuous, high speed drawing this higher titred soap will do a better job and if by chance for any reason it does not at your plant, it is not the fault of the idea of high titred fats but rather the inability of the soap maker to make it so that it is right for the job. The hardness, the titre of the soap, the richness etc. can all be controlled. It is also our contention that a soap made from tallow or other fat from which the glycerine has not been extracted, makes a better wire drawing soap. In other words we maintain, that a glyceride, that is

a fat that still contains glycerine, makes a better soap than one made from fatty acids. Aluminum and calcium stearate are made from fatty acids, and while they may be all right for drawing one or two holes, they are not good for six or more. We make some soaps from fatty acids, but they will not stand up for as many holes as the same type of soap made from glycerides. This was illustrated lately in a certain mill. They desired to draw three hole wire with a coating other than lime on the rods and desired a very clean finish. Grease would not do it, and when regular soda soap was tried, the wire scratched on the third hole. Then a soda soap made from a glyceride was tried and did the job satisfactorily and is now being used.

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IT is also at times necessary to blend different fats to arrive at desired results and this is getting more and more to be used. We have to admit that not enough is known about blending; we feel that when more is known the resultant soaps will be better. On certain types of stainless steel we might find it advantageous to blend two different soaps, maybe a high titred calcium soap to give the toughness desired and a lower titred soda soap with its lower melting point to give it the lubricity required or maybe a high titred soda soap to raise the melting point. On stainless steel we feel that there is still much to be learned, not only on coatings but on the type of lubricant to be used. It will be the purpose to supplant the expensive coatings now used such as lead or zinc and get something better than lime. At the time of writing this paper, we have heard of some coatings to do this, but we do not know personally about them. We believe that something along the line of the applied or synthetic sull coat mentioned before, will be able to do this.

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Wet Drawing

WE are concerned here mostly with dry drawing but feel as though we should mention something on wet drawing as there have been developments in this field too. There has been a tendency lately to increase greatly the speed of wet drawing, especially on such wire as screen cloth. And should the use of the very small tire wire come really into vogue, it would be necessary to draw this wire at high speeds and with a lot of efficiency to produce it at a cost attractive to the tire manufacturers. And there is a relationship between speed and costs and speed and efficiency. It does not necessarily hold that one mill running at say 2000 ft. per minute and another one at 1500 ft. that the first mill is getting that much difference in efficiency or that they are reducing their costs in that ratio. But with the proper set up, the proper coating and proper lubricant—and it is possible to run with the least amount of trouble such as tangles, changing dies etc.—you can increase speeds and cut costs. There is no sense in increasing speeds if your operator is going to have a lot of downtime.

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WE know of a mill which runs fine wire at a speed of about 2200 ft. per minute. One operator runs eight machines and when everything is going along pretty well, this operator can attend to all these machines and have very little downtime. From studying this operation, it would appear that this is almost the ideal setup for this mill. Formerly the machines were running at slower speed and the operator was still just running eight machines and a lot less tonnage was taken off. It just, in this case, due to the number of machines, worked out that he could not handle more machines even at the reduced speed.

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Effect of High Speed on Lubricants

WHEN the idea of faster speed came up we tried to meet it in two ways. Firstly by introducing a compound with more film strength and secondly one that would reduce surface tension. The commercial wetting agents did not seem proper for this as they tend to produce suds and they do not work too well with soaps and all wet drawing compounds are soaps of one kind or another, some having more free fats than others. So an agent that did not have this sudsing effect and was compatible with soap must be used. The results were good, but on concentrating on these two things we, to some extent, neglected the other part of lubrication, that is the slip, oiliness, or lubricity angle. All wet drawing machines have a certain amount of slip, and these are figured in the die reductions. We found, that on low carbon wire, we had concentrated so much on film strength and reducing surface tension, that we neglected the slip angle. The result was that we did not get the slip and the wire was pulled down and when it entered the succeeding die, was smaller than the reduction called for, and instead of hitting the angle of the die, it hit near the bearing and this will cause the die to pull out. This was an entirely new and different type of lubricant with an entirely new principle and it was to be expected that it would contain a few bugs that would have to be worked out. This can be done and is being done. Even on high carbon and stainless wire, where due to its hardness the wire was not pulled down, the additional slip should prove beneficial. Practically all wet drawing lubricants are made from low titred fats due to the fact they wet out better than high titred ones but with the agent for reducing surface tension, we believe it possible to use a really high titred fat and if so this will make a better lubricant.

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Non Ferrous Lubricants

IN the non-ferrous field we are what you might call, sort of **"Johnnys' Come Lately".** There has been very little change in lubricants for this work for a good many years and as we had nothing special to offer, confined ourselves mostly to ferrous metal. But we have now had some very successful experience in drawing non-ferrous metals and you cannot keep us from having some very definite ideas about it. We have drawn

(*Please turn to page* 448)

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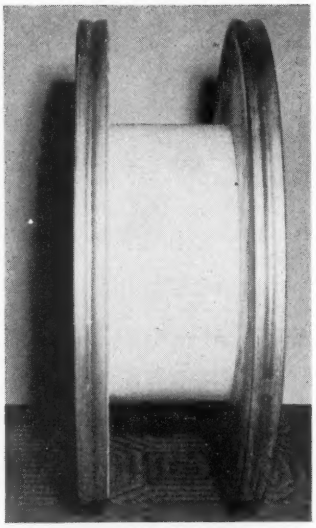

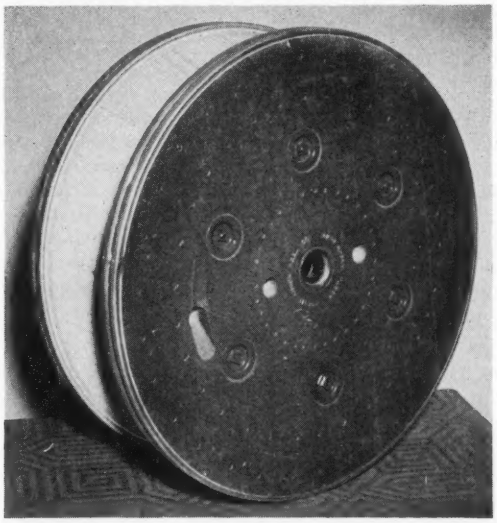

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A New Theory of the Plastic Deformation in Wire-Drawing

by R. Hill, M.A.,* and S. J. Tupper, M.A.,*
England.

A new theory is proposed to describe the stress distribution in a wire being drawn through a die. It differs from previous work in that the stresses and the plastic region are determined by considerations of the associated deformation. The theory is based on a two-dimensional model which, however, gives results close to actual experience. The drawing load is calculated for various die half-angles between 5° and 30°, and for reductions up to 50%. It is found that earlier theories considerably underestimate the die pressure and drawing load when the reduction in area is small. In extreme cases it is shown that the die pressure increases sufficiently to cause bulging in the metal surface about to enter the die. Simple methods of allowing for die friction and work-hardening are introduced. It is shown that there is an optimum die angle giving the least load for a given reduction and given frictional conditions; the optimum angle increases with reduction.

Introduction

MANY attempts have been made to calculate the force required to draw a wire through a die. Among early theories the most important was due to Sachs (1927).[1] Sachs' work has since been somewhat improved, principally by Körber and Eichinger (1940),[2] Davis and Dokos (1944),[3] and Lunt and MacLellan (1946).[4] Even so, the final theory is still unsatisfactory since it is based on arbitrary assumptions about the deformation and the extent of the plastic region. On the other hand, experience with other plasticity problems of axial symmetry indicates that the correct solution is likely to prove extremely difficult.

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AN exact solution can, however, be found for the two-dimensional analogue of wire-drawing where conditions of plane strain are prescribed. The material being drawn may be considered to be either a wide sheet, or a rectangular block in which lateral strain is artificially prevented. Apart from its intrinsic interest the plane-strain analysis has a practical value, since it is found that the calculated drawing force is close to the measured value under actual conditions. This, as we shall see, is not entirely fortuitous. Furthermore, the analysis assists a general understanding of characteristic features of the drawing process, such as the dependence of drawing force on die angle, the relatively large expenditure of non-useful work for small reductions in area, bulging in the metal surface about to enter the die, and the existence of an optimum die angle corresponding to minimum load. It has only been possible to include these features in previous theories by artificial and semi-empirical modifications.

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THE theory of plastic deformation under conditions of plane strain has been summarized and discussed in a recent paper.[5] The formulae and notation of that paper will be assumed without further explanation. The theory, in the first place, postulates an ideal material which is rigid up to a well-defined yield point and does not thereafter work-harden. Elastic strains are thus neglected; this is certainly permissible in a first treatment of drawing. It is, however, necessary to allow for work-hardening in calculations of the drawing load, and a simple treatment of work-hardening will be introduced. The present paper deals with the fundamentals of the drawing process. Such topics as the influence of back-pull, the phenomenon of bulging, and the bearing of the theory on empirical rules used in drawing practice, will be described in later papers. The present theory is also immediately applicable to an ironing process, where the wall thickness of a cup is reduced by forcing it through a die with an internal punch; this, too, will be the subject of a subsequent paper.

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Drawing Without Friction

IN our plane-strain model the die is wedge shaped, with total angle 2α, and cut back sharply at exit (see Fig. 1). For the moment the die surface is supposed to be perfectly smooth, and work-hardening is neglected. The initial and final widths of the metal are **D** and **d**, respectively.

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FOR a certain range of the reduction in area, the slip-line field in the region of plastically deforming metal is as shown in Fig. 1.[5,6] ABC is a region of straight slip-lines which are inclined at 45° to the die wall; in ACD and BCE the slip-lines are radii and circular arcs. DCEF is the region defined uniquely as the continuation from the circular arcs DC and CE; it has already been encountered in the problem of extrusion, where the slip-line net was calculated by

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a small-arc process.[5] The undetermined rigid part of the plastic region, lying outside the area of plastically deforming material, is not indicated. The magnitudes of the angles CBE = θ and CAD = ψ, are determined in terms of the dimensions of the die by the condition that the slip-lines ADF and BEF intersect the axis of symmetry at 45°. The variation of ψ with the die angle and the percentage reduction in area are shown in Fig. 2. By using the well-known geometrical property of slip-lines[5] it is easy to see that θ and ψ always satisfy the relation.

$$\theta - \psi = \bar{\alpha} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

By considering the sense in which metal crossing the curve ADF is sheared, the $\bar{\alpha}$ and β families of slip-lines can be distinguished as indicated in the Figure.

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THE verification that this slip-line field is compatible with the velocity boundary conditions is straight-forward. If the speed of the metal approaching the die is unity on some scale, the speed of the drawn metal is **D|d,** since conditions are steady and the volume change is negligible. The normal component of velocity along the slip-lines ADF and BEF is therefore known beforehand. The velocity solution can then be built up in the order DCEF, ACD and BCE, and finally ABC. Since the $\bar{\alpha}$ lines in ADC and the β lines in BCE are straight, and since the normal velocity components are uniform along each of AD and BE, the components normal to AC and BC

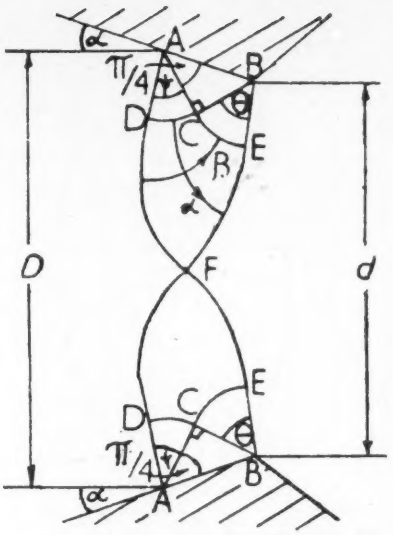

Fig. 1—Slip-line field in drawing through a smooth die. * * * *

are also uniform.* Hence the velocity within ABC is itself uniform. But the net outflow across AB is zero, since the outflow across BEF and the inflow across ADF have been taken equal. Hence the velocity in ABC would, when calculated, be found to be parallel to AB. The proposed slip-line field is, therefore, associated with a velocity distribution satisfying all the boundary conditions. Note the remarkable circumstance that this proof has been carried through without a detailed knowledge of the slip-line field and velocity distribution within DCEF.† The latter can be calculated when required. For the moment it is only necessary to observe that there is a tangential velocity discontinuity of constant amount $(D|d - 1)/\sqrt{2}$ across the boundary separating rigid and deforming metal. This is a consequence of the assumption of a plastic-rigid material. For a real material the discontinuity would be smoothed out into a transition region which would be broader the higher the rate of work-hardening.

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THE stress distribution corresponding to this field is determined from Hencky's relations (equation 2 of reference 5) once the mean compressive stress is known at any one point. This is found in terms of the applied back tension from the condition for equilibrium of the undeformed metal. The required front tension is then obtained from the condition for equilibrium of the drawn metal. The slip-line field is finally justified if it can be shown that the rigid material (non-plastic, plastic, or unloaded) outside ABD-EF is capable of supporting the applied stresses on it; viz., the calculated distribution along ADF and BEF, and the back and front tensions. It is assumed, in the absence of the full solution, that these forces can in fact be supported by a material in which a shear stress can equal, but not exceed, K (K = Y|$\sqrt{3}$, where Y is

* This may be immediately proved by an application of equation (2) of reference 5.

† It is assumed, of course, that the rate of work done on every element is positive, so that no element is unloaded. It is, strictly, necessary to verify this.

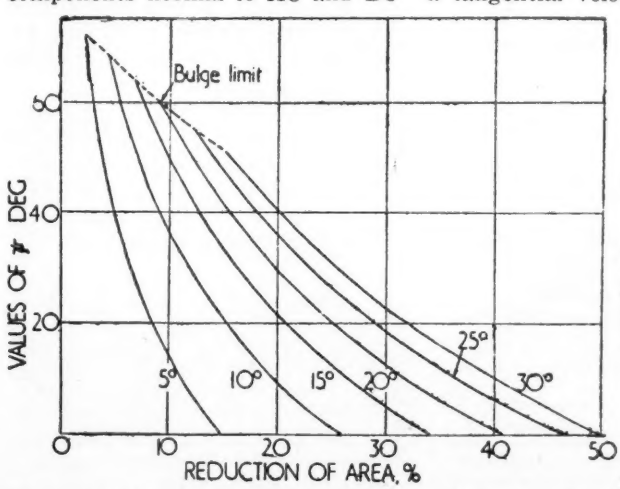

Fig. 2—Variation of angle ψ with die angle and reduction of area.

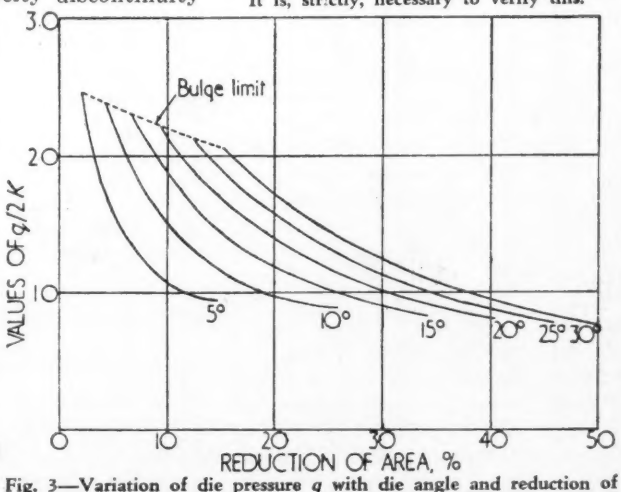

Fig. 3—Variation of die pressure q with die angle and reduction of area. * * * * * *

the tensile yield stress). For an intermediate range of reductions and die angles this seems almost certainly correct on general grounds. As we shall see later, it is not true for sufficiently small reductions, where theory indicates (and experiment confirms) the formation of a standing wave or bulge in the metal about to enter the die. At the other extreme, if the calculated mean drawing stress (load|final-area) becomes greater than 2K for sufficiently large reductions, it must be presumed that drawing is impossible under these conditions.

* * *

SINCE the slip-lines are straight in ABC, the pressure q on the die is uniform in the range of validity of the present solution. For zero back tension, q is plotted as a function of the reduction in area (1 — d|D) for various die angles as shown in Fig 3. It will be seen that q increases greatly as the reduction is decreased, so that die wear should be more severe for light reductions than for heavy ones: q eventually reaches the value:

$$2K(1 + \pi|2 - \alpha)$$

corresponding to the dotted curve. For this value of the die pressure a part of the metal surface ahead of the die becomes incipiently plastic (see Fig. 4), as though the die were an indenter being pressed into the metal. For still smaller reductions the theory indicates that

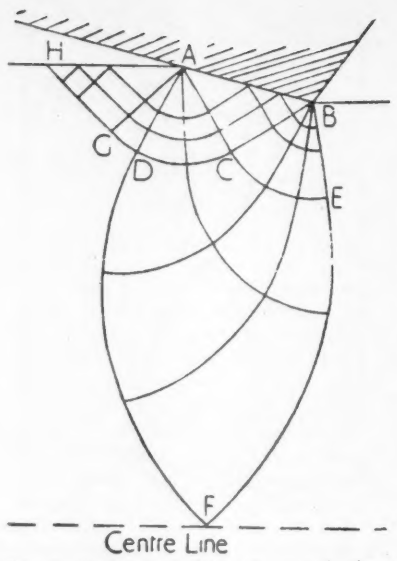

Fig. 4—Incipient bulging in metal about to enter the die. * * * *

a bulge will form ahead of the die; this has been observed in the ironing of cartridge cases[7] as well as in drawing solid wires.[8] The limiting value of the reduction when the bulge is just about to form will be called the bulge limit; it is of course a function of the die angle. Bulging will be considered in greater detail in a later paper.

* * *

THE drawing stress t, defined as drawing load divided by final area of drawn metal, is:

$$t = q(D|d - 1) = qr|(1 - r) \quad \text{.....(2)}$$

when the back tension is zero; here r is the fractional reduction in area, which is 1 — d|D for the plane-strain model: t is shown in Fig. 5 as a function of the percentage reduction in area for a series of die half-angles (5°, 10°, 15°, 20°, 25°, and 30°). Also shown is the curve:

$$t = 2K \log(D|d)$$

the plane-strain analogue of Sachs' original theory, based on the assumption of homogeneous extension. This formula underestimates the actual drawing stress by an amount corresponding to the "non-useful" work expended in shear deformation not contributing directly to the reduction in area; the error can be seen to be as much as 100% for low reductions. The non-useful work is proportionately greater the smaller the reduction and the larger the die angle. This has seldom been evident from experimental data, owing to the masking effect of die friction. Sachs' theory also greatly underestimates the die pressure when the reduction is small.

* * *

THERE is an upper limit to the range of reductions for which the present solution is valid, corresponding to $\psi = 0$ and $\theta = \alpha$. We then have a special configuration in which C and D, and E and F, coincide. It is evident that the fractional reduction for which this happens is:

$$r = \frac{2 \sin \alpha}{1 + 2 \sin \alpha} \quad \text{.....(3)}$$

This value of r represents the right-hand limit of the curves in Figs. 3 and 5. In this special case there exist simple analytical expressions for the drawing stress and die pressure:

$$\frac{t}{2K} = \frac{2(1 + \alpha) \sin \alpha \, q}{1 + 2 \sin \alpha}; \quad \frac{}{2K} = \frac{1 + \alpha}{1 + 2 \sin \alpha}$$

When $\alpha \sin \alpha > \frac{1}{2}$ (i.e., $\alpha >$ 42-45°), t is greater than 2K; the wire then fails in tension and can-

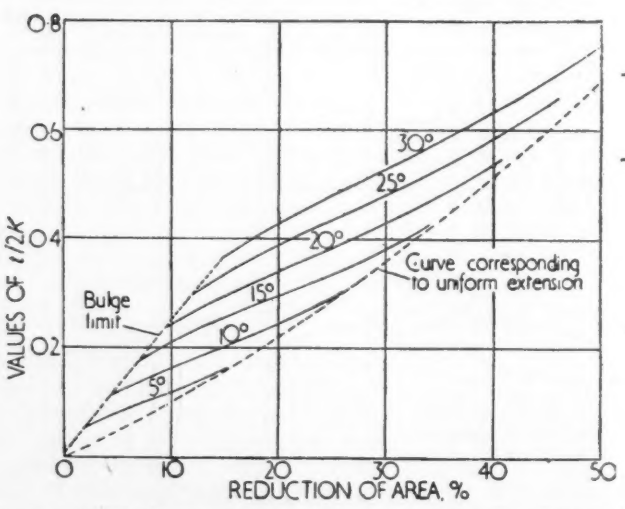

Fig. 5—Relation between drawing stress and percentage reduction of area for various die half-angles. * * * * *

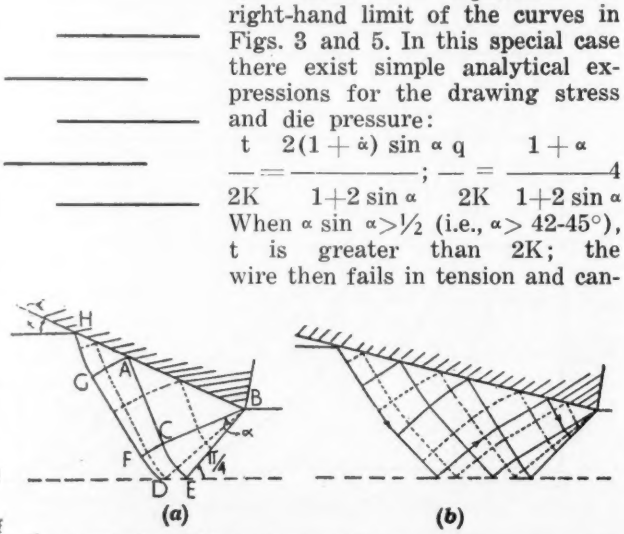

Fig. 6—Slip-line fields for large reductions. * * *

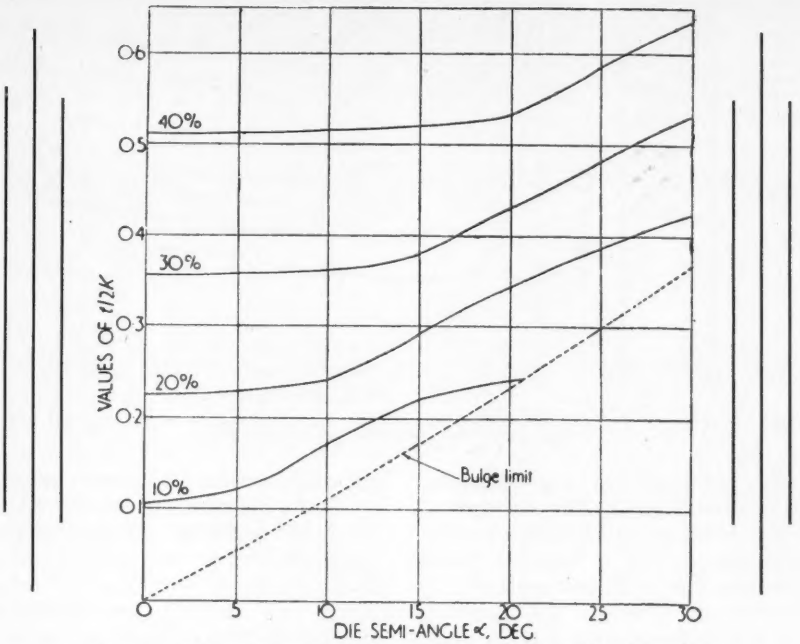

Fig. 7—Relation between drawing stress and die angle for various reductions in area. * * * * *

not be pulled through the die. For such large angles the special solution represented by equations (3 and 4) never becomes possible, and the solution of Fig. 1 extends to the largest practicable reductions. When $\bar{\alpha}$ is less than 42—45° there is still a range of reductions to which the solution of Fig. 1 does not extend for geometrical reasons alone.

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A NEW slip-line field is then required (see Fig. 6a). Region ABEC is as before. CDEF is the same type of field as in Fig. 1, but now the circular arcs defining it are CE and the reflection of CE in the axis of symmetry. ACFG is defined by the curve CF and the straight $\bar{\alpha}$ line AC; in this region all $\bar{\alpha}$ lines are therefore straight. AGH is defined by the β line AG and the condition that slip-lines meet the die wall at 45°. In the proof that this configuration is associated with a velocity distribution satisfying all the boundary conditions, the velocity solution must be built up beginning with region AGH (the only region where two boundary conditions are available **a priori**). It is only necessary to note that the velocity component along the curved β lines in ACFG is constant. The velocity in ABC is therefore uniform, and so the normal component across BE is constant and therefore compatible with the rigid body motion of the drawn metal. A tangential velocity discontinuity is propagated from H along the $\bar{\alpha}$ line to D and then along the β line to B. There is no discontinuity across the exit slip-line BE. The die pressure is still uniform along AB, but rises steadily from A to H.

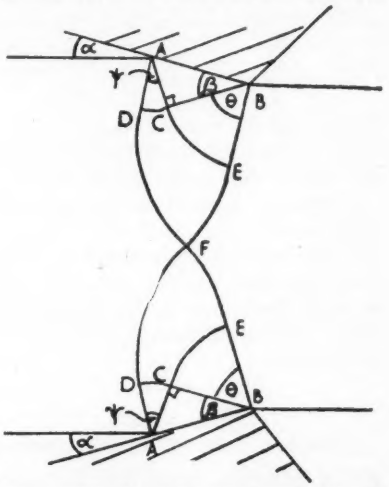

Fig. 8—Slip-line field for drawing through a rough die. * * * *

*This has been independently proposed by Sokolowsky,[9] who was not, however, aware of the necessity to justify the slip-line field by a consideration of velocities. Sokolowsky did not suggest any solution for the smaller reductions corresponding to Fig. 1.

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FOR still larger reductions (see Fig. 6b) it is natural to expect that the slip-line field would be simply the continuation of the field in Fig. 6(a).* It is disconcerting to find that this is not so, and the reason is curious. A velocity discontinuity is propagated from the die entrance along the arrowed slip-lines, finishing somewhere along the plastic boundary at the exit. This, however, is incompatible with the rigid-body motion of the drawn metal. So long as the discontinuity finishes on the exit corner of the die (as it will for certain ranges of D|d) the solution is valid. Otherwise the solution fails, and it is not clear what should be the correct one. A similar difficulty is met with in the compression of a block between smooth parallel plates, when the block extends outside the plates.

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FORTUNATELY, it is not necessary for practical purposes to calculate the stresses for the range represented by Fig. 6. The solution of Fig. 1 covers the reductions and die angles normally used. Furthermore, it will be seen from Fig. 5 that the asymptotic approach of the calculated curves to the curve of Sachs is already sufficiently close for an extrapolation to be made with confidence.

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Comparison With Experiment and Other Theories

THE most convenient set of experimental data appears to be that obtained by Linicus and Sachs for brass wires.[10] Linicus and Sachs estimated the friction by using rotating dies, and also obtained stress|strain curves for the drawn wires. They were thus able to make rough corrections for friction and work-hardening, finally constructing a graph of corrected drawing stress divided by yield stress plotted against the reduction in area. The agreement with Fig. 5 is remarkable, for example,

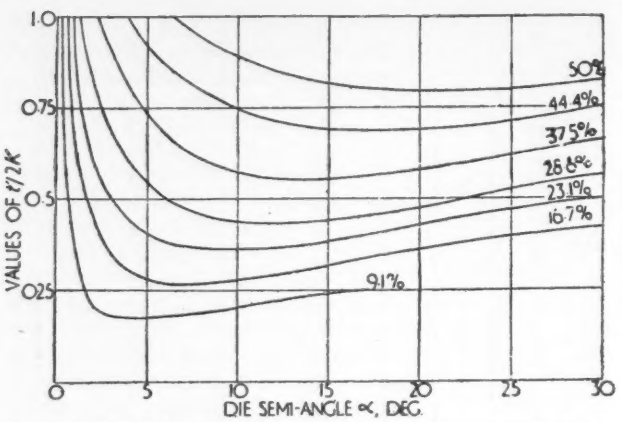

Fig. 9—Relation between drawing stress and die angle for rough die for various reductions: Coefficient of friction, 0.05.

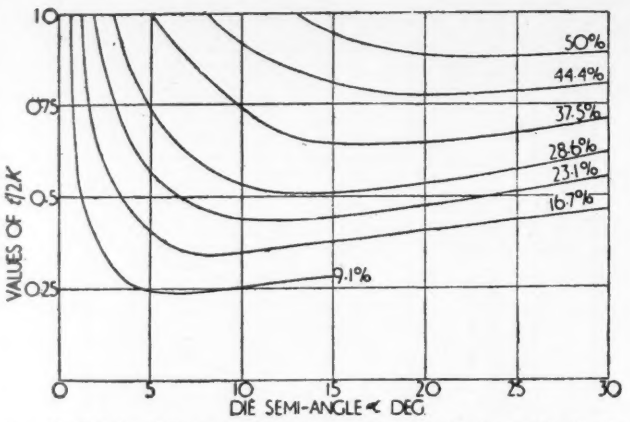

Fig. 10—Relation between drawing stress and die angle for rough die for various reductions: Coefficient of friction, 0.10.

in the spacing of the curves for different die angles, in the characteristic inflexion, in the asymptotic approach to Sachs' curve, and finally, in magnitude. There is a simple reason which helps to explain this possibly surprising correlation between plane-strain theory and three-dimensional experiment. If t|Y for a wire is plotted against some function of A|a (A = initial area, a = final area), and t|2K is plotted against the same function of D|d for the plane-strain model, the curves must coincide for sufficiently large reductions, since the expenditure of work is very nearly the same as in uniform extension. Under these conditions $t|Y \cong \log (A|a)$ for a wire, and $t|2K \cong \log (D|d)$ for the plane-strain model. For smaller reductions it is reasonable to expect that the dependence of the drawing stress on the die angle (for the same reduction in area) would at least be similar in the two cases. It is difficult to judge how close the agreement really is without a valid theory for a wire. It does seem, however, that such an empirical correlation is sufficiently accurate to be useful for calculating the load in drawing practice. In short, the drawing load, for a non-hardening wire with a final area (a) and a yield stress Y, is Ya × the ordinate of Fig. 5 for the corresponding die angle and reduction in area.

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IT is interesting to regard the expenditure of non-useful work in small reductions by considering the variation in drawing stress with die angle for a given reduction (see Fig. 7). The flat part of each curve to the left is an extrapolation of Fig 5 towards Sachs' limiting curve. Departure from the horizontal through the intercept on the ordinate axis gives a direct measure of the non-useful work. The dotted curve marks the bulge limit. For a given reduction, an increase of die angle produces an increase in die pressure, and ultimately the bulge limit is attained for some critical angle, unless tensile failure interposes (as it will for large reductions). Various artificial corrections to Sachs' theory have been proposed to allow for the expenditure of non-useful work. Of these corrections, that by Körber and Eichinger[5] is typical. They suggested that:

$$t|Y = \log(A|a) + 0.77a,$$

where a is the die half-angle measured in radians. This implies that the curve for each angle in Fig. 5 is spaced parallel to the asymptotic curve, and that the curves for the various reductions in Fig. 7 are parallel sloping lines. It can be seen that this is far from the truth, both qualitatively and quantitatively.

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Correction for Work-Hardening

FOR practical purposes the correction for work-hardening must be as simple as possible. It would certainly not be feasible to calculate exact solutions covering a range of die angles, reductions, and stress|strain curves, even were the exact solution known in principle and the law of hardening under combined stresses experimentally determined. On the other hand, the existing corrections for work-hardening introduced into Sachs' theory (for example, by Davis and Dokos[6]) are arbitrary and cumbersome. There is, in any case, little point in modifying a theory already much in error for an ideal material.

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THE correction now proposed for a work-hardening material being drawn through a **smooth** die may be stated as follows. The drawing stress is given by the area under the tensile-stress|strain curve‡ of the undrawn material, up to the strain equal to the ordinate of Fig. 5 for the appropriate reduction and die angle. This strain may be regarded as the equivalent mean strain imparted by the particular die; it is implied that the deformation is independent of the material and depends only on the die dimensions. This is presumably not strictly true, but it is probably a close approximation. The rule is evidently satisfactory when the material does not harden, since we have already seen that the drawing stress is Y × the appropriate ordinate of Fig. 5. The rule also leads to the correct result when the reduction is so large that the expenditure of work is effectively the same as in uniform extension. The equivalent strain is then just log (A|a). In

‡ The stress|strain curve referred to is that where true stress is plotted against logarithmic strain.

general the correction may be made plausible by an argument based on the concept of a generalized stress|strain curve and the observation that the drawing stress is equal to the mean work of deformation per unit volume. The merit of the rule lies, however, in its simplicity and general appropriateness, and it is offered here on that account only.

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IF the rule be true, the yield stress of the drawn wire is equal to the ordinate of the stress|strain curve of the undrawn metal at the equivalent strain. Thus the stress|strain curve of a drawn wire should coincide with that part of the curve for the undrawn metal lying beyond the equivalent strain (apart from the effects of necking). The comparison of the stress|strain curves of drawn wires has normally been based on the assumption that the deformation in drawing is uniform extension, i.e., the equivalent strain has always been equated to log (A|a). As we have seen, this is very much in error for small reductions and large die angles.

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The Influence of Die Friction

IT is easy in principle to modify the slip-line field of Fig. 1 to allow for friction on the die wall. The fundamental difference is that the slip-lines in ABC do not meet the wall in 45° (see Fig. 8), so that the circular arcs CD and CE are no longer of equal radius. If β denotes angle ABC, and q′ is the normal pressure on the die, then:

$$\cos 2\beta = \mu q'|K, \quad \ldots\ldots (5)$$

where μ the coefficient of friction, is supposed constant along the wall. If angles CBE and CAD are denoted by θ and ψ respectively, it follows from the geometrical property of slip-lines that:

$$\theta - \psi = \pi|4 + \bar{\alpha} - \beta. \quad \ldots\ldots (6)$$

When there is no back tension, the drawing stress is:

$$t' = (1 + \mu \cot \bar{\alpha})\ (D|d - 1)q' \ldots (7)$$

A numerical calculation of q′ inevitably depends on @ trial-and-error process. For any initial choice of β the slip-line field is fixed by geometry. The normal pressure on the die, q′, is then determined by the condition for equilibrium of the undeformed metal. β must be varied until this value of q′ also satisfies equation (5). The numerical labour is prohibitive since the field DCEF has to be calculated afresh at each stage.

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AN analytical solution can, however, be found in the special case when $\psi = 0$ and $\theta = \pi|4 + \bar{\alpha} - \beta$ corresponding to:

$$D|d = 1 + \sqrt{2} \sin \bar{\alpha} \sec \beta. \quad \ldots\ldots (8)$$

By the use of Hencky's equations

$$t'|K = 1 + 2(\pi|4 + \bar{\alpha} - \beta) + \sin 2\beta - q'|K \quad \ldots\ldots (9)$$

when the back tension is zero. Representative values are given in Table I for typical die angles and coefficients of friction in drawing practice.

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IT will be observed that the drawing force is greatly increased by the presence of die friction, particularly with small die angles.

(*Please turn to page* 443)

Table I
TYPICAL VALUES OF DIE PRESSURE AND DRAWING STRESS

Semi-angle α	μ	β	Reduction in area, %	q′|2K	t′|2K
5°	0	45°	14.8	0.92	0.16
	0-039	43°	14.4	0.90	0.22
	0-079	41°	14.0	0.88	0.27
	0-121	39°	13.7	0.86	0.32
10°	0	45°	25.8	0.87	0.30
	0-041	43°	25.2	0.85	0.35
	0-083	41°	24.6	0.84	0.40
	0-126	39°	24.0	0.82	0.45
15°	0	45°	34.0	0.83	0.43
	0-042	43°	33.3	0.82	0.48
	0-086	41°	32.6	0.81	0.52
	0-130	39°	32.0	0.80	0.56
20°	0	45°	40.6	0.80	0.55
	0-044	43°	39.8	0.79	0.59
	0-088	41°	39.1	0.79	0.63
	0-133	39°	38.5	0.78	0.66
25°	0	45°	45.9	0.78	0.66
	0-045	43°	45.0	0.77	0.70
	0-090	41°	44.2	0.77	0.73
	0-135	39°	43.5	0.77	0.76
30°	0	45°	50.0	0.76	0.76
	0-046	43°	49.1	0.76	0.80
	0-091	41°	48.3	0.76	0.83
	0-137	39°	47.6	0.76	0.86

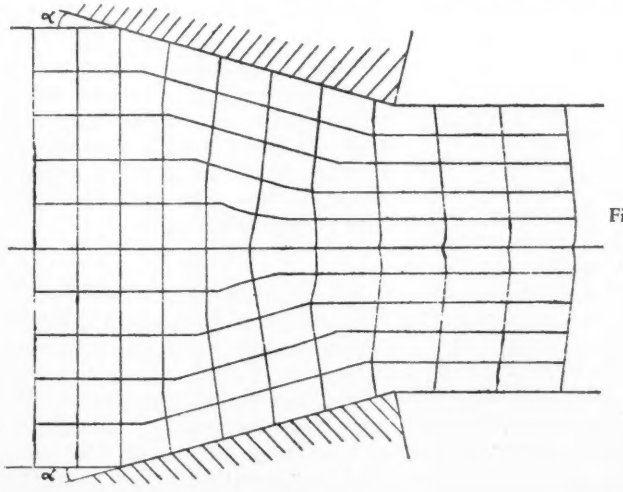

Fig. 11—Deformation of a square grid for $\bar{\alpha} = 15°$ and a reduction of 34.1%.

Aluminum Wire

Section III

WIREDRAWING MACHINES

By N. Davidson, Esq., A.M.I. Mech.E., Assoc. M.C.T.

Technical Director to Sir James Farmer Norton & Co., Ltd., and Director and General Manager, Wire Drawing Dies (Manchester) Ltd.

Wire Drawing Machines

PART A

BEFORE we analyze the method of producing aluminium wire, it is necessary to remember that this gathering is chiefly composed of men who are primarily interested in steel wire production. The reason for this interest in aluminium is that owing to the great difficulties encountered in obtaining sufficient supplies of steel rods essential to service existing plants, the user of steel wire cannot obtain sufficient supplies and consequently is anxious to obtain substitutes. We are therefore, finding that a considerable demand is growing for such articles as barbed wire, chain link fencing, fencing wire, hexagonal netting, woven mesh, wire guards, and similar articles, which formerly were made exclusively in steel or mild steel and which now can be easily produced in aluminium. To keep their existing plants in full operation a few firms with suitable equipment, endeavored to maintain turnover with stainless, nickel chrome and steel alloys in general, but found the difficulties of obtaining rods unsurmountable. Aluminium wire was produced in quantities by the non-ferrous Companies in the days when the "Grid" system was under construction, and existing facilities would have met the demand, but the copper wiredrawing firms were already inundated with orders for the electrical industry.

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DURING the war years considerable plant for the manufacture of aluminium in general was constructed to meet the requirements of the aircraft industry. When the demand ceased, on cessation of hostilities the aluminium producing concerns themselves were anxious to obtain markets where aluminium and its alloys could be consumed. Consequently any article which could be constructed of aluminium was of interest. Within a few months the pots and pans, kettles, greenhouses, and structural buildings were in evidence, primarily for the export and eventually for the home market. The wire consumer was interested in the lightness of the new product and its non-rusting properties. The Cable maker was interested in its lightness and conductivity, especially if he could not obtain deliveries of the essential copper wire necessary to keep his plant in operation.

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THE net result is that we have an increasing number of steel wire manufacturers anxious to increase their knowledge and experience in drawing aluminium, consumers who are anxious to obtain supplies of a substitute for steel and aluminium producers who are anxious to obtain new markets for their material. Many firms could undertake to supply the demand, but are fully booked with orders necessitating concentration on the production of copper wire.

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IN studying the question of wiredrawing machinery for producing aluminium wire, we must remember that the large producers of copper wire have plants which were originally intended to specialize in copper production. It was soon found however, that these could be converted to drawing aluminium with very little alteration. The speeds of drawing were similar, continuous reductions could be undertaken by somewhat similar passes and naturally when the great demand came for aluminium wire during the years of the "Grid" construction, the copper wire manufacturing concerns played the leading part. Copper wire firms have been producing aluminium wire for many years at speeds which to the steel producer are fantastic. Today we have been discussing drawing speeds of a few hundred feet per minute. When I commenced work in 1918 the first machine observed was drawing 15 s.w.g. aluminium in 9 holes from the rod at 1,000 f.p.m. In a few years production speeds rose to 2,000 f.p.m. and higher and it was no surprise to find one of the Technical Committees investigating German practice found 5/16" aluminium rod was being continuously drawn to .072" at 3,000 f.p.m. I would not regard 4,000 f.p.m. as being extraordinary although this has not yet come within my experience.

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MY own firm was established in 1852 and looking up some information in preparation for our centenary, I found that we made wire machinery almost at the commencement of operations. One of our early pamphlets illustrates continuous wire drawing machines

Section III of the series of four sessions on aluminum wire embraces lectures on a) wire drawing machines, b) wire drawing dies and c) wire drawing lubricants. These, are part of the four sessions on aluminum wire at the Staff School of Frederick Smith & Co., Ltd., at the Caledonian Works, Halifax, England.

suitable for drawing aluminium wire: a 5 die machine drawing 3 to 13 s.w.g. on 16" block at 80 r.p.m.; another model 4 to 17 s.w.g. at 100 r.p.m. on 16" block; and five different models from heavy wire to fine wire, the latter drawing 200 r.p.m. on 8" block. These were made before I was born, don't forget, and long before the synthetic die was invented. Occasionally we get enquiries for spare parts and a short time ago I saw a number of these machines in operation. They had been constantly in use for 45 years producing aluminium wire by continuous holing.

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LET us now consider the more modern types as used by the non-ferrous trade. First we have the rod machine, usually of the tandem type. This is a machine of robust construction designed for large diameter rod reduction in 6 passes. In principle 5 drums or capstans, each 22" diameter are rotated at predetermined speeds by means of worm reduction gears, these being connected by means of flexible couplings. Machines similar in principle, but different in drawing mechanism are used all over the world. Before they can function satisfactorily, a certain percentage of slip must be introduced, the drawing drums being arranged to rotate at a greater peripheral speed than the wire is being drawn at each particular reduction. For example if the finishing block is drawing a finished wire of .104" through a .104" finishing die, at 1,000 f.p.m. the inlet wire being .128" it would be necessary to feed the die at a rate of 660 feet per minute to allow for the elongation. To produce this 660 feet per minute of .128" size wire the drawing capstan would be arranged to give a peripheral speed of 700 f.p.m. For commercial reasons the wire manufacturer wishes to draw with a selection of drafts. If he wants to finish with a light hole the 700 f.p.m. would not produce sufficient wire to feed the final die. Should a final draft of 19% area reduction be desired to finish at .104" the wire entering the die would be .116" and would have to be fed at the rate of 805 feet per minute. This cannot be accomplished by a capstan designed to produce at 700 f.p.m. Consequently the designee has to compromise and fix his capstan speed to suit, probably at 850 f.p.m.

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WE can thus easily see that if the capstan speeds are fixed and various reductions are undertaken, the wire slipping on the drums can be a detrimental factor, producing excessive heat and a waste of power. In the example above the capstan would be drawing at a fixed speed of 850 f.p.m. and the wire at 660 f.p.m. and 805 f.p.m. according to the draftings. We are not primarly interested in the finer points of the design of rod machines, but on investigations I made over 25 years ago I found that 40% of power was being wasted and that the slip caused defects on the wire which were difficult to eradicate. This was noticeable particularly on aluminium where the metal was on the soft side, the slip of the capstans on the wire creating flats on the surface at the point of contact on the drum. This only goes to show the advantages of non-slip machinery, but one must not forget that on slip machines very high speeds are obtainable and by introducing features such as variable speed on the final block and rotation of the last die, the defects can be minimized.

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THE 9 hole rod machine is based on the same principles as the 6-holer, but essentially used for drawing 3/8" or 5/16" rod to 15 s.w.g. or thereabouts. In this case the drawing capstans are 18" and the machine can be used for drawing direct on to block or on to spool. It is very robust and is capable of speeds about 3,000 f.p.m. and under certain conditions 4,000 f.p.m. In this case the block is driven by independent motors to give facilities for varying the slip, and to produce wire delivered at the 5th drum onwards. This is a desirable feature as the heaviest reduction should be undertaken at the input end of the machine, the final block speed being reduced accordingly to synchronize with the intermediate capstans when short holing is desired.

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IT is very interesting however, to note the similarity of principle of design in the machines made in the last century and present day practice. Robustness of construction and engineering design are not comparable. We manufacture machines because the customer wants them, but we have always designed better ones when the machine is the result of co-operation between designer and user.

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WE also make a machine for reducing rods in 6 passes. It is a large cone type machine and made specifically to save space. It has several novel features of interest, namely independent pull-in gear, swaging machine for pointing, traversing dieholders, and an outboard bearing to the cones. The largest cone you will notice is adjacent to the centre bearing thus avoiding the overhang of heavy cones. Liquor is pumped under pressure into the dies and on to cones and it is a very useful machine, where only 5 or 6 reductions are necessary before annealing. It is based on the slip principle, the peripheral speed of the individual cones being somewhat similar to those of a tandem machine. It is rather more difficult to thread when compared to a rod machine, which incidentally requires a special stringing-up machine but grooves in the cone flanges and the auxiliary drawing-in bench enable it to be accomplished in a few minutes. It is not as robust as a tandem machine and has the disadvantages of most cone machines, the thicker wire has to be drawn on the smallest diameter cones. Nevertheless on account of space saving and price it can be very useful when a small number of reductions are required.

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ANOTHER of our machines is a multiple die machine in which the drawing operations are accomplished whilst totally submerged in a bath of lubricant. Consequently the wire, dies and drawing cones cannot become overheated particularly as facilities are included to

cool the lubricant itself if necessary. Pumps and jet lubrication of the die is dispensed with, and as the wire and cones are always totally submerged there is always a film of lubricant between the wire and the face of the cone enabling the wire to slip more easily. The normal drawing speed is between 3,000 and 4,000 f.p.m. and a number are in operation at 5,000 f.p.m. This particular machine has an inlet of .160" for aluminium and on the Continent there are many machines of a similar design and principle and a number of heavier construction, these normally producing from 3/8" rod to 15 s.w.g. at 3,000 f.p.m.

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STILL another is a machine based on the same principle but for finer wires. It is made as a single unit or two machines can be arranged to work with a single liquor trough. Used for non-ferrous metals in particular, it can finish all sizes of aluminium between 30 s.w.g. and 40 s.w.g. at 3,000 f.p.m. Recently it has been used very successfully for multiple holing of zinc, and brass; bronze and mild steel wire is and has been drawn on this type for a number of years in this country. Continental manufacturers use it extensively for aluminium, probably on account of its efficiency due to the complete submerging of the drawing operation. The cones are vertical when drawing and the usual cantilever effects being eliminated.

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ONE of our machines is a totally different type. The machine works on the slip principle, but the cones are completely dry and not lubricated in any way. It is only used for extremely fine wires down to 50 s.w.g. and is only arranged for spool production. The demand for large quantities of extremely fine aluminium wire is not yet very large in this country and I have not heard of any request for sizes in the region of .0001" such as can be produced by one of the American Aluminium Companies. Nevertheless now that we can make diamond dies successfully to .0004" there may be a demand in the future for wires down to this latter size.

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OTHER types are typical intermediate machines, both do the same job, but on different principles. The 13 die machine is a smaller edition of the machine for 6 passes. It has one idler cone and one drawing cone, the dieholders traversing in a rotary movement to traverse the wire across the cone and clean the die entrances of foreign matter. Lubrication is by a jet of liquor forced into the die under high pressure. The TF2A is the alternative machine whereby the whole process is totally submerged.

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NEXT come our strip blocks, one for heavy sections and the other for light sections such as tape. In this case the coils are wound on the drawing block and do not rise up the block in the usual manner. They are wound in a flat pancake coil, the inside diameter being 12" and the outside probably 30" diameter.

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THE foregoing descriptions are representative of typical machines used for aluminium production. Some are a specialized design, but in general they are the types of equipment used for non-ferrous material. They are interesting because the average steel man does not get many opportunities in England to see how the non-ferrous man operates. There is one type however with which he is familiar, the non-slip accumulation type of machine and I now propose to describe suitable types used for aluminium drawing.

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DURING the war years there was a demand for a quality of aluminium and aluminium alloy which could not easily be obtained on the conventional type of machines. Most of it had to be single holed, processed and then reduced further by single holing. After a few experiments we found that by drawing the initial passes at a slower speed and the subsequent passes at a higher speed, a certain amount of processing could be avoided. Consequently the G.M. 1 type of machine was adopted for continuous production. Each operation, being on non-slip principles, resulted in a better quality than was formerly produced and by introducing wet drawing methods, a better finish was obtainable. Machines on this principle were therefore introduced into the companies primarily concerned with aluminium, to produce wire drawn to stringent specifications and results were very satisfactory. This should be very interesting to steel wire manufacturers, since almost without exception they have been installing G.M. 1, G.M. 2, and G.M. 3 machines since 1932. Consequently they possess plants which are suitable for the modern methods of non-slip drawing.

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NOT until after the war ended did we discover that the non-slip principle for aluminium drawing was preferred on the Continent. One of these is a 10 block G.M. 2 machine which is capable of drawing 12.0 m/m to 2.5 m/m at 1,200 f.p.m. complete with arrangements for winding on to large spools. Machines on the same principle are equipped for inlets of 16 m/m to finish 5 m/m in 7 reductions, others 10 m/m to 1.4 m/m in 12 continuous passes. By this method only the actual power to produce the reductions is used, the drawing is non-slip and consequently a better surface can be obtained. Each block and each die is water cooled adequately, and control of each pass is under complete observation. Depending on how far the material can be drawn without annealing, G.M. 2s can be combined with G.M. 3s and the machine broken down for finishing on intermediate blocks if necessary. To the steel man the advantages are obvious. He can buy machines suitable for aluminium and later use them for steel or conversely. The speeds of production cannot be as high as the most modern copper practice, but there is every possibility of producing better qualities, because of the different principles involved. For obvious reasons one cannot divulge the progress being made on non-slip machines of various designs, but we have already produced combination machines of the G.M. 1 and G.M. 2 type and machines which combine the G.M. 1 and the

slip machine. Capstan machines of the non-slip D. C. automatic adjustment were introduced in 1937 and have been constantly in operation, but there are developments in the offing which will be placed on the market at some future date.

* * *

AN interesting machine which will appeal to specialists in straight lengths is the continuous drawing, cutting off, straightening and polishing machine. All the operations are embodied in one single machine. Aluminium wire can be drawn through a die, straightened and cut off to a predetermined length and polished. Whether this will be a benefit to the industry remains to be seen, but mention of it is made as a matter of interest.

* * *

Discussion on Wiredrawing Machines

OWING to pressure of time this subject could not be fully discussed.

* * *

Mr. Brook

IF I might venture a personal comment we should be very grateful to our friend Mr. Davidson if he could put all this information into a booklet suitably illustrated. I think Sir, that it is one of the most valuable contributions that I have ever heard.

* * *

Mr. Davidson

I TOO, think that there is a need for such a booklet.

* * *

Mr. Peter Smith

THE most interesting fact to which Mr. Davidson has drawn attention is the use of machines designed for copper drawing and machines designed for ferrous drawing as an alternative means of drawing aluminium wires. It appeared to us that Copper drawing firms could invade some of the markets of the mild steel trade by substituting aluminium wire drawn on their copper machines. It is therefore, a satisfactory thing to know that Ferrous wiredrawing machines are equally suitable mediums for aluminium drawing.

* * *

Wiredrawing Dies

By N. Davidson, Esq., A.M.I. Mech.E., Assoc. M.C.T.

PART B

THERE is not much time left for me to discuss developments on dies for drawing aluminium. Indeed, development was not particularly requested until the steel manufacturer entered the aluminium arena. We were content to supply dies to customers requirements and leave it at that. Suddenly the demand changed. From several sources we received requests for dies made to particular profiles. Orders poured in for dies with 25° reduction angles, 30 to 40% parallel and an exit angle of 25°, the front and back end to be well rounded or bell mouthed (Fig. 1). The actual bearing was placed a distance of 2/3rds. of the total depth from the front of the die. Enquiries from various sources elicited the fact that this design was eminently suitable for drawing aluminium. It has been my experience that dies for aluminium should have a wide entrance for the lubricant to enter easily and the foreign matter such as aluminium oxide to get away, but there is one interesting development which might be suggested. As the reduction angle and exit angle are both 25° and both entrance and exit are well rounded we should try out dies where the bearing or parallel portion is centralized and the whole die made symmetrical. You could then have virtually a double die, the entrance and exit angle being equal, and use it as a two-way die. A slightly deeper pellet may be necessary and a slightly larger point required for threading, but the advantages would outweigh the disadvantages. Owing to the low stresses involved in aluminium drawing, a suitable mount could be designed for two-way drawing.

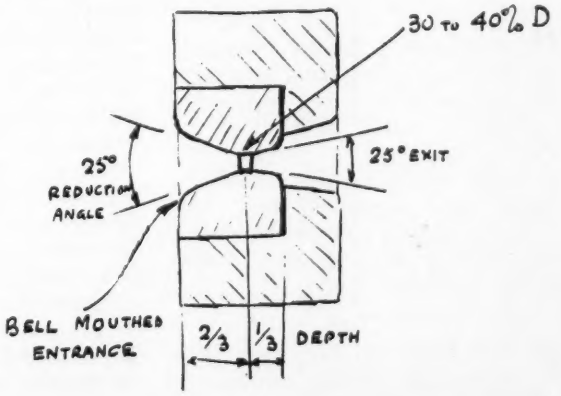

Fig. 1.

Tungsten Carbide Die Profile Popular at the Moment. Reduction Angles Are Gradually Reduced to 18° as Wire Tensile Increases.

EXPERIMENTS are being conducted at the moment in our tungsten-carbide factory to find a better mixture for aluminium drawing. Previously the metal used for drawing copper has been supplied, but it is known that aluminium or aluminium oxide which may be invisible to the naked eye, can be very abrasive. That is why dies for aluminium drawing should be very highly polished. We are therefore, engaged in finding suitable metals which will be harder, perhaps more brittle, but which will give a high polish to minimize the friction. We have already produced the special high grade powders necessary for a brilliant high grade polish and in due course these will be placed at the disposal of the users for maintenance purposes.

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WITH regard to diamond dies, it is very difficult to produce a very smooth entry. The reduction bearing, relief angle and exit can be highly polished but owing to the design of present day polishing machines it is not an easy matter to provide dies highly polished throughout the full depth of the diamond. As the diamond is encased in a brass or bronze mount the bell mouth of the mount is comparatively soft and there is a tendency for foreign matter to collect around the reduction angle. It should be swilled away by the impinging jet of lubricant of course, but this is not always possible, since some of the lubricants used produce "sticky" wire. In consequence the effect is to collect particles of foreign matter in the die mouth, in a somewhat similar manner one obtains when drawing badly coated galvanized wire or heavily coated coppered steel wire. The net result is that imperfect lubrication ensues, breakages or sucking down are in evidence.

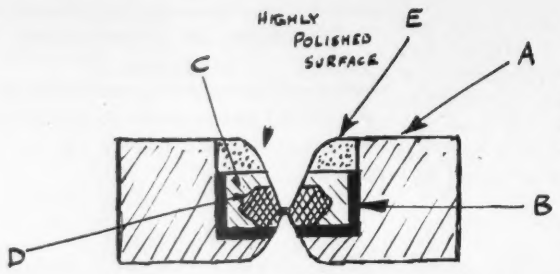

Fig. 2

Diamond Die with Tungsten Carbide Entrance Cone.
A—Brass or Bronze Case
B—Steel Cup to Hold Reinforcing Metal
C—Reinforcing Metal
D—Diamond
E—Tungsten Carbide Pellet

★ ★ ★

STUDYING this feature of fine wire aluminium drawing it was considered desirable to design diamond dies with a very smooth entrance. Illustration 2 shows a diamond die reinforced in the usual way and made according to British Specification Standards. It has however, a tungsten-carbide entrance in the form of a pellet inserted in the mount, the entrance is exceedingly highly polished and can be maintained in this state quite easily. This is really a simple innovation but I think it will be very effective in helping to obtain better lubrication and die cleanliness.

Lubrication in Aluminium Wiredrawing

By A. L. H. Perry, Esq., B.Sc. (Tech.), F.I.M.
Technical Assistant, The Shell Petroleum Co., Ltd.

PART C

Introduction

ALUMINIUM is a soft metal, and consequently the die pressures set up when it is drawn into wire are comparatively low compared with, say, those with steel, or even copper wire. It is easy to find lubricants to withstand these low pressures, and aluminium therefore, presents one of the simpler wire drawing lubrication problems.

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IN the past, and even now to a considerable extent, the speeds used in drawing aluminium wire have been quite low—only a few hundred feet per minute. Like the low die pressures such low speeds also help to keep the lubrication problem simple, because they give rise to no difficulties in meeting those ancillary lubrication problems—keeping the system cool and attaining good die life. Of course, the growing demand for aluminium wire is now leading to the use of much higher drawing speeds. So far as I am aware, however, these increased speeds have not yet lead to any marked change in lubrication practice, but should they go on increasing, then modifications may be necessary to meet the new conditions. For example, aqueous emulsions may then dominate the field, as has happened in the high speed drawing of copper, where the high cooling power of such emulsions has become the controlling factor in lubricant selection.

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Classes of Lubricants

BECAUSE of the simplicity of the drawing problem a consid-

erable variety of lubricants has been used with success, and consequently there is so far nothing that can be considered as universal, orthodox practice in the field. I therefore propose to describe all the various types of lubricant which I know to have been used for this purpose and to give some indication of the qualities and merits of each.

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THESE lubricants may be conveniently classed as follows:-

(a) Oils.
(b) Aqueous Emulsions.
(c) Non-Liquid Lubricants.

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(a) Oils

STRAIGHT mineral oils of suitable viscosity make good lubricants for aluminium and are widely used. Incidentally, this is an indication of the relative simplicity of the problem since straight mineral oils are only adequate for relatively mild lubricating conditions.

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THE viscosity of the oil is chosen to suit the particular diameter of wire. With heavy gauge wire, die pressures are sufficiently high to compel the use of oil of fairly high viscosity in order to give the necessary film strength to prevent scoring. As the wire gauge drops the viscosity can be correspondingly lower. For example, to break down rod of ¼"—⅜" section, oils of a minimum viscosity of about 1000/1500 Redwood I at 100°F. are necessary but for very fine wire (say .005" and less) a viscosity of only 50 Redwood I at 100°F. is high enough. For intermediate sizes, oils with viscosities between these limits are used.

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APART from their adequacy as lubricants, mineral oils have the advantage of being cheap, readily obtainable, and free from corrosive action. Being liquids, moreover, they act as coolants, though they are not so efficient in this way, particularly the viscous grades, as aqueous emulsions.

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INSTEAD of straight mineral oils compounded grades, i.e. mineral oils with a proportion of fatty oil, are often used. I have found a fatty oil content of about 2½%/5% to be quite satisfactory, with viscosities the same as for mineral oils. The fatty oil reduces the coefficient of friction between die and wire and is thus favourable to obtaining good die life and keeping the system cool. Against these advantages, however, must be set the increased price of compounded over mineral oils.

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(b) Emulsions

EMULSIONS used in drawing fall into two classes—those made from pastes, and those made from soluble oils. The pastes are based upon some suitable fat, such as tallow or rape oil, which is rendered emulsifiable by some appropriate means, such as sulphation or partial saponification. Other substances, such as free fatty acids and mineral oils, may also be incorporated. Soluble oils, on the other hand, consist essentially of a mineral oil and an emulsifier, though many other substances may also be present to give particular properties, such as freedom from foaming and high stability. Each of these types of product, on mixing with water, gives an emulsion and these emulsions combine excellent lubricating and cooling properties. The pastes are the better lubricants, because of their high fat content, and consequently they tend to be used for heavier wire, in which die pressures are too heavy for the soluble oil emulsions. These, however, are adequate for the fine gauge.

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THIS practice—paste emulsions for thicker wire, soluble oils for fine wire—is of course very well known in the case of copper wire, and these lubricants are also used on the same basis for aluminium wire. They must be selected, however, with due regard to the fact that aluminium is rather susceptible to pitting and staining by aqueous solutions. In particular, the corrodibility of aluminium under alkaline conditions is a potential source of trouble with many paste emulsions, which is a main reason why these are not more used.

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THE main advantage of emulsions over oils is their higher cooling power, which is a consequence of the very high specific heat of water compared with oil. As already indicated, their superiority in this respect may in time lead to the wider use of the emulsions, as speeds of drawing increase.

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(c) Non-Liquid Lubricants

WHEN the drawing benches available are not suitable for a liquid lubricant, aluminium can be drawn very satisfactorily by the use of a suitable grade of petrolatum as lubricant. Petrolatums are mixtures of soft waxes of low melting point produced in petroleum refining. Besides providing efficient lubrication they leave a thin film on the wire after drawing, and this makes a good protection against atmospheric corrosion. Petrolatum has been used quite considerably in this way, for instance in Germany.

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BEING of a grease-like consistency, petrolatum has no cooling properties, and is therefore, only suitable for slow speed drawing.

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GREASES themselves are reported to be sometimes used, though I have never seen this myself. The only objection to them is their soap content; because of this, traces of lubricant left on the wire may give rise to corrosion under damp conditions. Another point is that soaps tend to cause staining on annealing.

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WHILE on the subject of non-liquid lubricants, it may be mentioned that dry soap powder; as used for steel wire, is quite effective as a lubricant for aluminium wire, but suffers from two defects. Firstly, its very efficiency as a lubricant prevents the polishing action of the die; the wire consequently has a bad finish. Secondly, as with greases, residual

(*Please turn to page* 446)

Portsmouth Steel Corporation

A description of the expansion and improvement program that has been in progress in Portsmouth since 1946.

SINCE the Portsmouth Steel Corporation acquired the Wheeling Steel Corporation's plant located at Portsmouth, Ohio, on July 1, 1946, they have instituted and energetically pursued a comprehensive program of expansion and improvement. This program has been designed to expand the productive facilities of these properties from a strictly coarse low carbon merchant wire mill to a modern wire mill capable of producing low and high carbon wire in both the coarse and fine wire fields.

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BEING a completely integrated mill, the program has embraced all phases of steel manufacture, rolling, and wire operations. Numerous improvements have been made in the open hearth and rolling mills, and major outlays for improvements have been made for the rod and wire mills.

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STARTING with the rod mill, additional laying reels have been added to the original reels which has facilitated continuous three-strand rolling in the mill, and resulted in a marked increase in rod capacity. Studies are now being made to make possible the rolling of a larger billet which will further increase the productive capacity of this mill.

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THE improvements in the wire mill began with the installation of a modern straight-line cleaning house capable of cleaning approximately 1000 tons of rods per day. The installation consists of acid cleaning tanks, spray and water rinse, lime and special coating tanks, sul racks, and flash bakers. It replaces the old circle type cleaning house and tunnel bakers that had been in operation since the building of the plant. This accomplished not only a substantial increase in cleaning capacity but also a sizable reduction in cost.

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INASMUCH as the original mill was not equipped for the manufacture of high carbon wire, these facilities had to be installed. In the past two and one-half years our Engineering Department, in conjunction with leading combustion and construction engineering firms, has designed and built rod and wire patenting units and oil tempering units, which has made possible the production of high carbon wire in a more complete range of sizes and specifications.

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ANNEALING facilities consisted of the conventional coal-fired furnaces when the plant was acquired by the Portsmouth Steel Corporation. These have been replaced with Lee-Wilson bell-type annealing furnaces equipped with atmospheric generators of the most modern type. Suitable atmospheres can be produced for all types of annealing, including bright and decarburization free high carbon annealing.

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MODERNIZATION of the wire mill proper has proceeded along three general lines; namely: (A) Improvement and regrouping of existing equipment; (B) Installation of new equipment; and (C) Complete relocation of equipment designed to lend itself to the incorporation of modern handling methods. These changes will be discussed briefly below.

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(A) The improvement and relocation of existing equipment has been in accordance with the dictates of modern wire drawing experience and consists of such things as the installation of rod welders, flippers, water cooling of blocks, etc. Wherever feasible, existing equipment has been rebuilt and modernized so that speeds which are comparable to those employed in modern drawing equipment are attainable.

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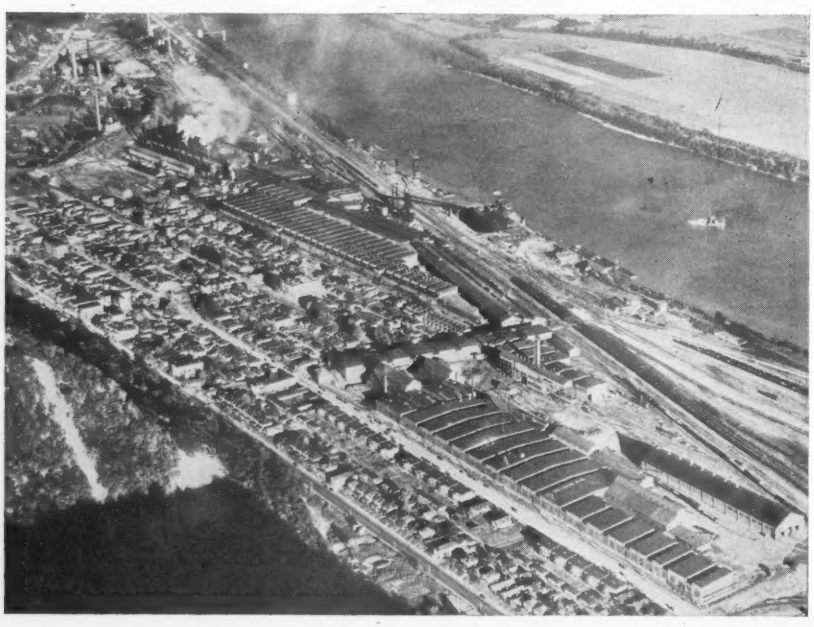
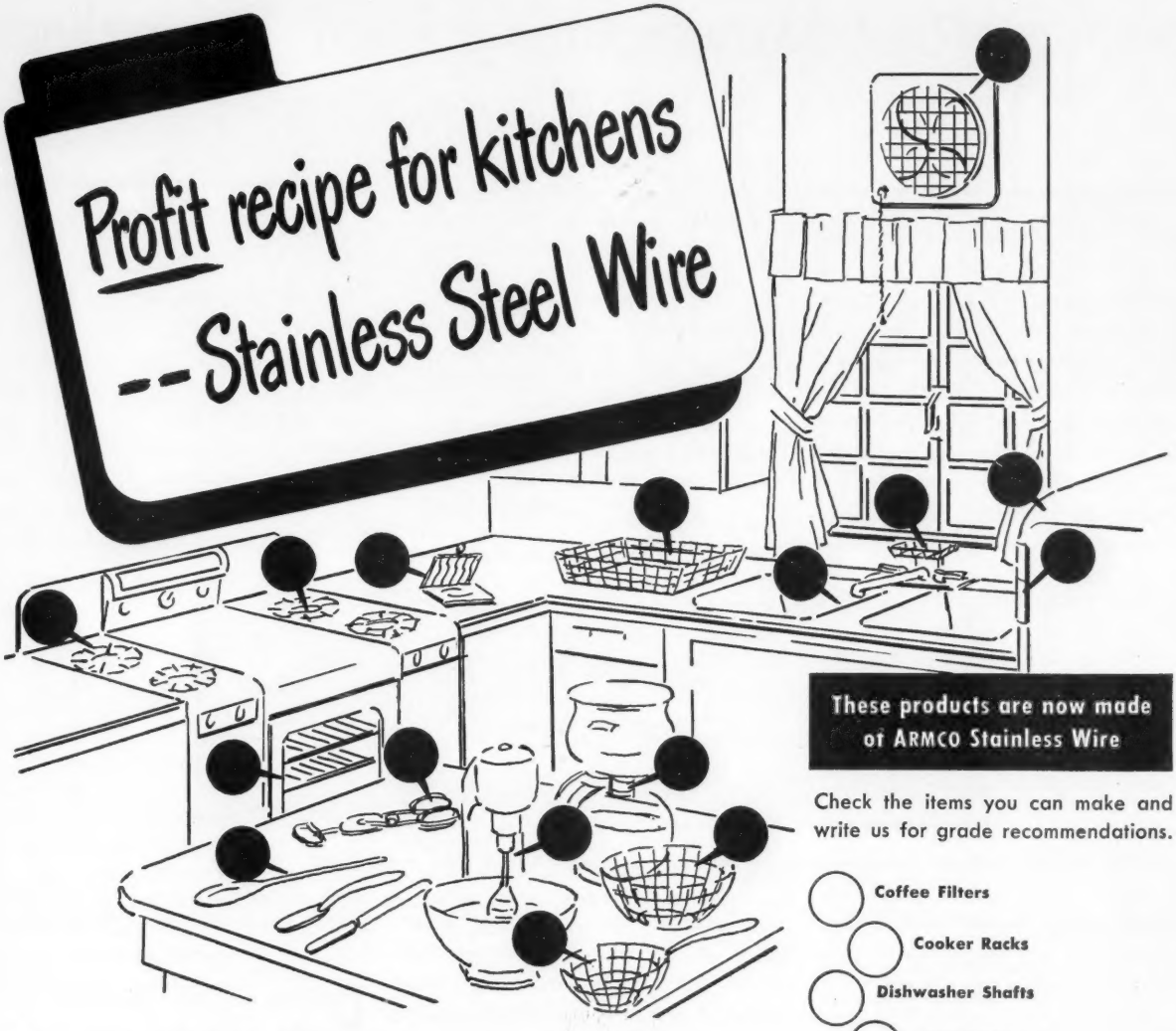


Plane View of Portion of Portsmouth Plant on the river at Portsmouth, Ohio. * * *

Profit recipe for kitchens --Stainless Steel Wire



These products are now made of ARMCO Stainless Wire

Check the items you can make and write us for grade recommendations.

- Coffee Filters
- Cooker Racks
- Dishwasher Shafts
- Egg Beater
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- Electric Fan Guard
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- Kitchen Tools
- Nails, Screws
- Oven Door Springs
- Refrigerator Hinge Pins
- Refrigerator Shelves
- Soap Dish
- Utensil Handles

Stainless steel wire belongs in the modern kitchen. And more manufacturers of kitchen utensils or equipment are changing every day to this rustless wire—for its lasting beauty and irresistible sales appeal to the American housewife.

There is a place for *you* in this profitable stainless wire fabricating business.

You can fabricate ARMCO Stainless Steel Wire on the same machines you use for regular steel, with slight changes in procedure. You can draw, form, cold-head, or swage stainless wire, and it is readily welded or soldered.

When kitchen equipment or parts require beauty, permanent rust resistance, great strength, or heat resistance—ARMCO Stainless Steel Wire will do the job *better*. And quite often stainless steel products cost less because plating expense is eliminated. This solid, rustless metal also gives your customers some strong and convincing selling points.

The list on this page shows a few of the many kitchen products made of ARMCO Stainless Wire. Check it with your prospects and customers—then let us work with you on a cost-analysis for specific products. Write Armco Steel Corporation, 230 Curtis Street, Middletown, Ohio. Export: The Armco International Corporation.

ARMCO Stainless Steel Wire ARMCO

Modern Reel Manufacturing Plant Streamlined For Efficiency

Even workaday products, normally considered easy to manufacture, are made successfully and at reasonable prices, if the processes by which they are made embody the best modern production methods. The mill described here is an example of good production practice. Good methods keep a source of supply in business. It takes capital and brains, a combination that is evidently combined here.

—Editor's Note.

THE manufacture of wooden reels for wire, wire rope and electric wire and cable is not just a matter of purchasing a lot of lumber, saws, drills, nailing machines and running the wood through the machines. To secure maximum efficiency as to speed and costs, the raw materials and tools, as in any good manufacturing establishment, need to be arranged so that work flows with a minimum of lost motion from lumber-yard to shipping room.

* * *

STREAMLINING of production has been carried out to the n-th degree in the straight-line flow of work through the plant of the **Bridge Manufacturing Company** at Hazardville, Connecticut, where lumber becomes well-made reels of diameters of from twelve to ninety-six inches, in a matter of minutes.

* * *

THE business itself enjoys a location that is central to a large number of mills that, within a two-hundred mile radius, covers an important segment of the wire rope and electric cable manufacturing industry in this country. It was started in a modest way as a box-making plant in 1929 and shortly thereafter a few reels were made by request. In 1930 four or five customers were added, giving the Bridges an idea that there might be a field here to cultivate.

* * *

DOUGLAS C. BRIDGE, who sold boxes and reels for the Company became manager in 1938 and from that point a consistent program of enlargement and improvement has been followed, culminating in the present layout.

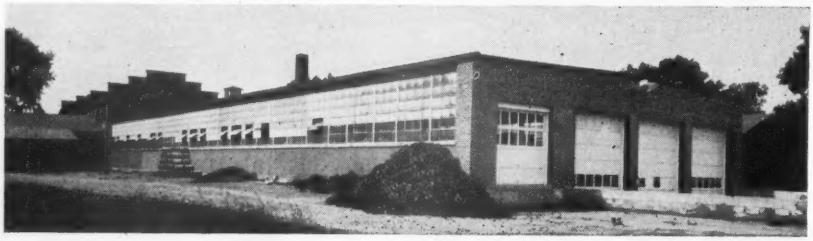

Fig. 8. View of assembly and shipping end of plant, showing doors through which trucks enter and leave the building.

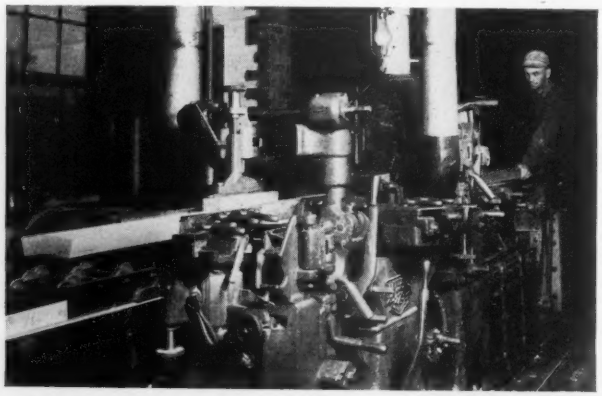

Fig. 1. Molding machine shaping lumber to form stays for reel drums. This machine is adjustable to take any size or cut any arc desired.

Fig. 2. Making reel head blanks on forming tables, the first step in the manufacture of reels. These are tacked together by hand.

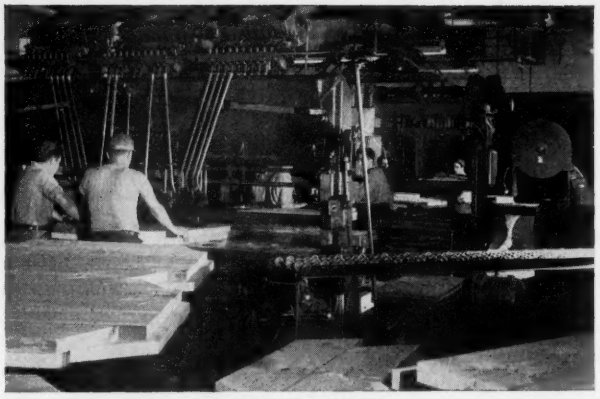

Fig. 3. Beginning of the production line looking down the shop. The nailer is in the foreground, behind which is seen the borer. The nailer fixes reel head members permanently into one piece. Nails are driven at such points as will not interfere with subsequent operations.

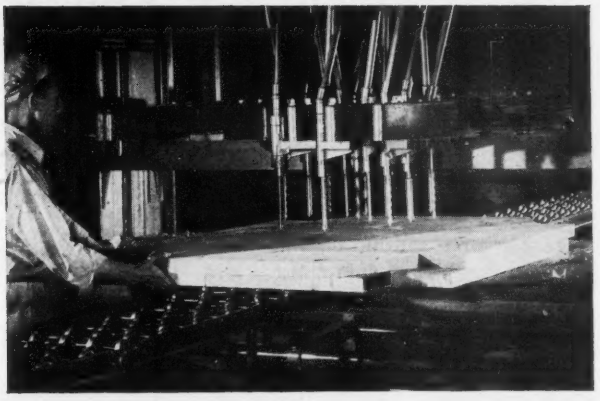

Fig. 4. Multiple spindle reel borer drilling the arbor, bolt and other holes in one operation.

Douglas and two brothers, **Rockwell** and **Dudley**, run the business, now wholly devoted to the manufacture of reels.

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PRACTICALLY all of the major equipment in the plant has been made to order to suit the requirements of a highly specialized business. The Bridges think nothing of scrapping expensive machines, if they can design new ones that will be faster or more versatile and efficient. Even now, changes are being planned that will further speed production.

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THE company is interested in several lumber producing concerns and maintains a stock of lumber of from 4 to 5 million feet in various stages of air-drying, a process that takes from six to twelve months in the seasoning of the wood to the degree necessary to make good reels. About two million feet of this is kept on hand at the Hazardville plant.

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FOR smaller reels, the blanks for the heads are made at the lumber yards and shipped to the plant ready for use. Larger blanks are made in Hazardville on forming tables in a room provided with equipment for planing and cutting to size. This is one of the initial steps in the making of reels.

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ANOTHER, at the front of the plant, is carried on in a room in which lumber stock is shaped in molding machines and then cut to proper lengths to form the stays that will be used to form the reel drums. These stays pass directly to the assembly room at the rear of the plant, where they are stacked for use. Ample stocks of stays for all standard sizes of reels are manufactured in advance and kept on hand.

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HOWEVER, from the front of the plant, where reel head blanks are made or stored, there begins a series of operations in which the reel heads flow in a steady stream to the assembly and shipping room, at which point long trailer trucks, under cover, are continuously loaded.

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HEAD blanks first travel to two lines of nailers, capable of driving 30 nails at one time using nails of any desired size up to 5″ in

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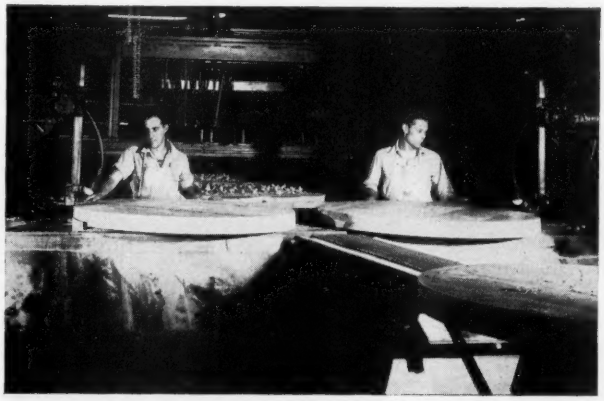

Fig. 5. Reel blanks being cut to circular shape on cutting bands. Blanks can be seen on a conveyor enroute from the borer to the saws.

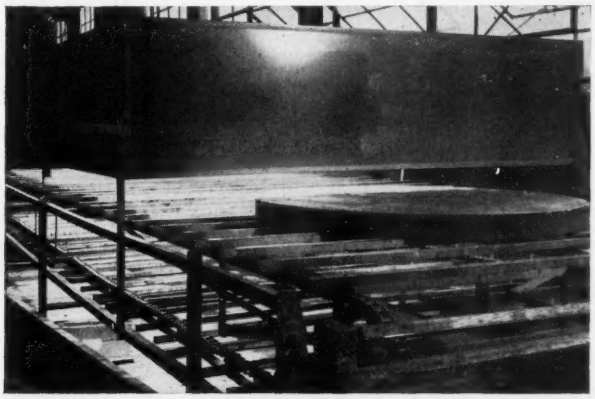

Fig. 6. Infra-red drying oven showing painted reel head passing through on conveyor and emerging dry.

Electrical and Allied Developments of 1948

By Guy Bartlett

General Electric Company

Schenectady, New York

A digest of a twenty-two page report, covering a wide variety of electrical and allied developments.

MOST outstanding of the engineering developments and trends of the electrical industry during 1948 were those in the field of power production—in the development of new and more efficient apparatus, and in investigations leading to better understanding of the fundamentals of high-temperature and high-speed metallurgy.

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OF import in the field of power generation was the Research Laboratory announcement that a new aluminum alloy has 2½ times the elastic strength and only 1/10th the true creep rate of "electrical conductivity" or E. C. grade of aluminum, and at the same time has satisfactory conductivity. A trace of magnesium makes the difference. It is expected to permit further development of large generators and also to serve as a generally useful replacement for hard-to-get copper.

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KRYPTON, one of the rare and inert gases present in the atmosphere to the extent of one part in a million, was given a job to do in fluorescent lamps. Replacing argon which is far more common—nearly one part in a hundred in the air—this gas is used in a new fluorescent lamp of the same high light output, long life and outside dimensions of the older 100-watt lamp but uses only 85 watts.

Industrial X-Rays

BROAD new fields of application for x-ray diffraction in the identification and quantitative analysis of unknown materials were opened by a high precision, high-output machine announced by the General Electric X-Ray Corporation, Milwaukee. One of the many attachments, a fluorescent analyzer, greatly extends the range or composition of materials which can be analyzed.

★ ★ ★

A 10,000,000-VOLT betatron was produced at Schenectady and installed during the year at the Naval Ordnance Laboratory, White Oaks, Md., for special industrial research radiography. It can x-ray rolled steel 10 inches thick at a distance of six feet in 30 minutes —eight times as fast as a 2,000,000-volt equipment.

Cable

SEVERAL installations of high-voltage cable during the year represent the first of their kind. High-pressure gas-filled cables of the pipe type, and of mass-impregnated construction, were installed and are operating successfully; the only previous gas-filled pipe type cable installation in this country was of the preimpregnated variety.

Carrier Current

IN a new system of power-line carrier-current control, the extreme selectivity of its sensitive receivers is provided by quartz crystals which enable long-distance transmission of various control signals such as telemetering, load control, transfer trip, and supervisory control. Narrow band width permits several of these individual control channels to be tucked away into a small portion of the overall frequency spectrum.

Control

A "STRONG - BOX" magnetic coil — so called because the winding is so thoroughly protected —is a feature of a group of a-c contactors that is the heart of a new line of full-voltage magnetic motor starters. A plastic enclosure gives protection to the coil windings against humidity, dirt and oil, as well as mechanical protection during handling and installation. Laboratory tests indicate a life expectancy of the coil about twice that of a conventional coil.

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FOR smooth, stepless speed control of lathes, grinders, conveyors and mixers there is a midget Thy-mo-trol, a small adjustable-speed drive giving d-c flexibility from a-c power. The speed range is from 86 to 1725 rpm. A new photoelectric smoke-density equipment, having a short-time delay to prevent false operation of the alarm relay from sudden puffs of smoke, will ring an alarm or operate motors to reduce excessive smoke.

Industrial Wiring

FLEX-A-POWER, a plug-in or trolley busway designed primarily for lighting and small power outlets, was made available in 50-amp capacity by The Trumbull Electric Manufacturing Company of Plainville, Conn., a G-E manufacturing affiliate. The new trolley is especially applicable for fluorescent lighting fixtures of apartment houses, garages and home workshops, large stores, and factories.

Industrial Heating

INDUCTION heating methods during the year continued to find many new applications in industry for annealing, brazing and soldering. Typical of improvement

(*Please turn to page* 451)

Announcement of the

PACIFIC COAST REGIONAL MEETING

of the

WIRE ASSOCIATION

THE TIME: JUNE 3, 1949.

THE PLACE: LOS ANGELES, CAL., AT THE LOS ANGELES BILTMORE HOTEL.

THE PROGRAM:

Registration: At 5 P.M. at the Biltmore Hotel.

Plant Visit: Rod and Wire Mill of the Bethlehem Steel Company. Busses leave the hotel at 11 A.M.

Dinner: 6 P.M. at the hotel.

Technical Paper: "The Waste Pickle Liquor Problem." To be presented by Wallace G. Imhoff, Consulting Engineer, Los Angeles, California.

Films: "Rubber Insulated Cables"—shown through the courtesy of the Okonite Company, Paterson, New Jersey, and
"Voices in Paper," a film depicting a new method of applying pulp paper directly to wire—shown through the courtesy of the Western Electric Company.

FEES: Registration, including dinner and attendance at technical session $5.00
Bus tickets for Plant Inspection $1.50

Please send your reservation today

THE WIRE ASSOCIATION

300 MAIN STREET

STAMFORD CONNECTICUT

Executive Secretary
RICHARD E. BROWN
The Wire Association
Stamford, Conn.

Meeting Chairman
E. N. COFFIN
Columbia Steel Company
Los Angeles, Cal.

V 24/5

INDUSTRIAL DIAMOND ASSOCIATION
OF AMERICA, INC.

I. J. MEADE, President | JAMES A. ROSS, 1st Vice-President | WALTER J. MEINHARDT, 2nd Vice-President

Communications:
ATHOS D. LEVERIDGE
Executive Manager & Secretary-Treasurer
501 LEXINGTON AVENUE
NEW YORK 17, N. Y.
WICKERSHAM 2-1400

Suggestions for Production and Economy through Industrial Diamonds

By W. F. G. Kerley England

This paper was selected as the best paper on the economical use of diamond tools in a contest sponsored by the Industrial Diamond Association of America, Inc., and the author received an award of $100.00. The paper is being published by permission of the Association.

* * *

THE generalizations covered by the introduction of this article have been omitted and only the technical portion of the paper is given herewith.

* * *

The 6th in a series of letters addressed to the Wire Drawing Industry.

IT is well known to the diamond technologist that no two diamond crystals are alike. After a score or more years of diamond cutting one acquires great analytical competence so that the 'sight' of the goods alone will communicate to the cutter exactly what individual treatment is required to produce a precision tool of great accuracy.

* * *

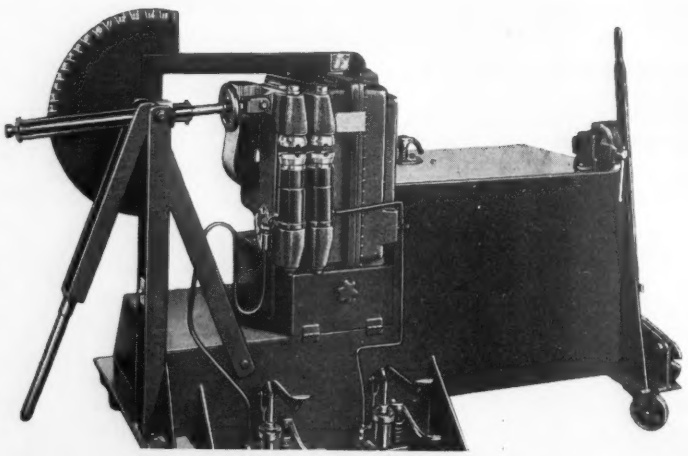
THUS, as each diamond crystal possesses a definite individuality it is not surprising to learn that it is the practice in British diamond die manufacturing technique to give the stone individual treatment in practically all the manufacturing stages. Each crystal is first held in a mechanical dop for polishing base, top and window facets, it is then spotted and countersunk by hand and sent to the piercing section where again each stone is fixed on a separate machine set to drill the precise contour and intended size of the die bore.

* * *

THROUGHOUT the whole process, individual and specialized treatment is given to the diamond right up to the final mounting in

MICROMETER PRECISION — MICRO WELD — TRADE MARK REG. U. S. PAT. OFF.

MODEL L-3 MICRO-WELD BUTT WELDER



This type welder is available in three Models (L-1) (L-2) (L-3) for welding COPPER Rods and other non-ferrous metals ranging in size from 5/16" to 7/8" diameter.

The illustration shows the Model L-3 MICRO-WELD Butt welder, equipped with foot operated hydraulic clamping mechanism, radius grooved welding dies and die shoes, and with a single control lever for the spacing operation, and contacting the welding switch.

Welders can be furnished on stationary base, or mounted on 4-wheel truck.

MICRO PRODUCTS COMPANY
20 NORTH WACKER DRIVE
CHICAGO 6, ILL.
Telephone: STATE 2-7468

MY 49
UMI

the die case; multiple machine and batch methods are not used until the encased or repolishing stages.

★ ★ ★

THE result is a well made tool that gives dependable service.

★ ★ ★

THIS is not however the whole story for the rising cost of labor makes one explore the possibilities of greater machine efficiency with something akin to desperation, and in this effort to promote greater machine efficiency many of our existing methods must be examined in the light of modern research.

★ ★ ★

I TRUST that none of my readers will now adopt the 'glassy eye' of the shop foreman when the word research is mentioned, not that we can blame the foreman, for the presentation of pure scientific research is seldom interpreted on an elementary basis. However, applied research of a modest character as described below can be of great value in assessing one's own shortcomings as well as gauging the strength or weakness of the competitor market.

★ ★ ★

AS a producer and consumer of diamond wire drawing dies I have been able to make thousands of drawing tests with diamond dies of all the leading American and European makes. These tests were made with stainless steel and nickel-chromium wire drawing, a factor favoring rapid quality and quantity analysis.

★ ★ ★

IN addition to diamond die Life Tests the following methods were used in distinct relation so that the maximum data was available, they fall into two groups (1) Tests on diamond dies purchased from all sources. (2) Tests on diamond dies manufactured on our premises.

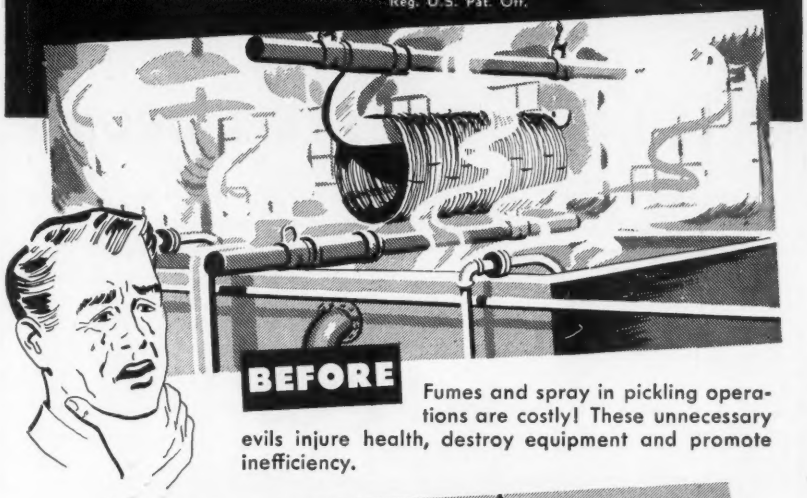
★ ★ ★

DIAMOND dies purchased were examined for carat weight to die bore ratio, contour of drawing zone measured, the mounting

NAME YOUR POISON....

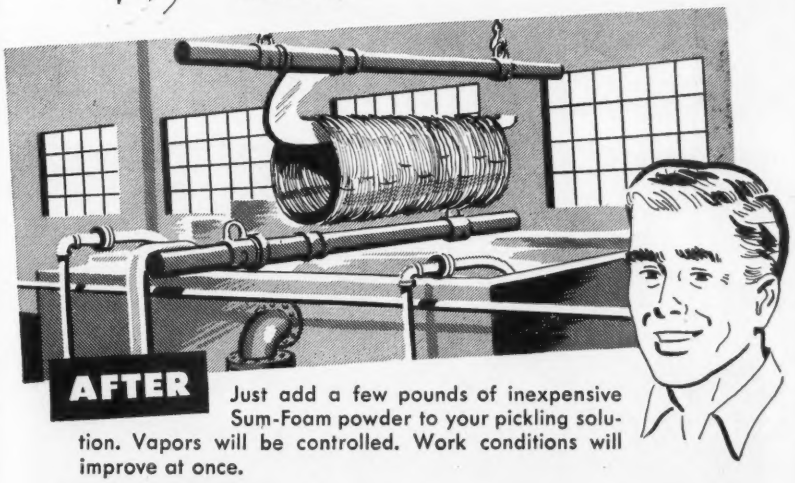
.....is it pickling without Sum-Foam?

Reg. U.S. Pat. Off.



BEFORE

Fumes and spray in pickling operations are costly! These unnecessary evils injure health, destroy equipment and promote inefficiency.



AFTER

Just add a few pounds of inexpensive Sum-Foam powder to your pickling solution. Vapors will be controlled. Work conditions will improve at once.

FREE

50 LB. BAG

LET US PROVE TO YOU WHAT Sum-Foam WILL DO

SHIPPED PREPAID ANYWHERE IN U.S.A.
FOR ANY PICKLING OR ACID CLEANING OPERATION

WRITE! TELEPHONE! WIRE!

(This offer expires in 90 days)

Wm. M. Parkin Company
Highland Building
PITTSBURGH 6, PENNSYLVANIA
MOntrose 0176

PICKLING SPECIALISTS
Parkin of Pittsburgh
IN STEEL SINCE 1860

REELS made of

RETURNABLE AND NON-RETURNABLE **WOOD**

12" to 96" in diameter
for complete reels and

REEL HEADS FOR STEEL DRUMS

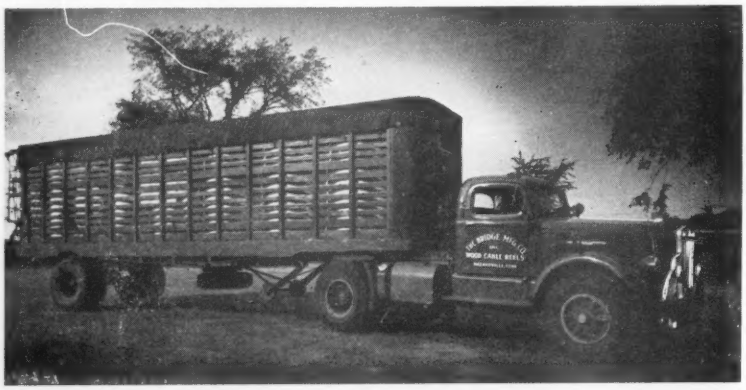
Bridge SHIPPING and SHOP REELS are furnished assembled or knocked down, made to your specifications. Built to withstand severest handling. Sturdy, strong, low in cost. Made for

CABLE,

ROPE and

WIRE

and delivered anywhere within a radius of 200 miles of Hazardville by means of Bridge trucks.



This service includes over-night delivery of reels, in case of urgent need, direct to your plant. You are invited to avail yourselves of this unique and convenient facility.

Send us your specifications and let us quote on costs.

BRIDGE MFG. CO., Inc.

HAZARDVILLE • CONNECTICUT

material tested for hardness—reinforcing strength—melting point and the calculated heating duration and temperature for depositing the metal around the stone, also the orientation of crystal structure in relation to die bore axis and the observed and estimated method of manufacture. To do this of course the diamond was removed from its setting and frequently it was necessary to polish windows for die inspection and microscopic contour measurement. Removal of the diamond for crystal structure examination was done without heat so that a true picture of the original heat effect on the stone was presented.

★ ★ ★

DIAMOND dies made on our premises were subject to similar tests but with the added advantages of knowing the origin of the diamonds used and their behavior during working into dies. The tests were confined to the range of wire drawing considered generally as fairly costly (i.e.) uncoated wet drawing of Stainless Steel and Nickel-Chromium wires in sizes from .048 in. dia. to .006 in. dia. and were principally concerned with reinforced die mountings.

★ ★ ★

FROM .006 in. dia. to .0009 in. dia., low melting point mounting media and even cold set diamonds were satisfactory.

★ ★ ★

Mass-Production of Diamond Dies Favored

AT the conclusion of these tests I found the following points favorable to a mass production technique for diamond dies. There is little doubt that the reinforced type of die mounting is an improvement on the older types; economy of diamond alone is a great feature; stones of ¼ carat weight are now used where formerly a one carat stone was necessary.

★ ★ ★

ALTHOUGH diamonds may be satisfactorily reinforced against the stress set up by wire drawing, there is a danger that the high melting points of some of

the metals used will at least cause superficial burning of the diamond. This is particularly noticeable when the diamond is drilled and polished before mounting.

★ ★ ★

A FURTHER point that suggests modification of structure takes place within the crystal is that no matter what the orientation of crystal structure to die bore, ultimate breakage or flawing through overwork always takes place laterally, mainly from impingement point. Grain and cleavage directions also become more troublesome in the drilling and polishing processes after mounting by most reinforcing methods.

★ ★ ★

HAVING formed the opinion that the orientation of crystal structure is not a factor of major importance to die life when diamonds are subject to the usual conditions of commercial reinforced mounting, we can readily see that it would be an advantage to encase the whole natural crystal before working it and so provide a sound structure unaffected by any weakening of the diamond such as cutting away the natural crystal boundary and also at the same time offsetting any harmful effect caused by superficial burning of the die bore in the mounting process. The conserving of the original diamond dimensions by such a process also enables the die maker to make larger initial die bores (see the table of carat weight to die bore ratio with stone dimensions) but it is sufficient here to note that we have in suggestion already broken away from our specialization program.

★ ★ ★

IF we adopt the suggested method of fully encasing the whole natural diamond before working it, then we need not consider the grain and cleavage directions or scaife plate work, in fact we take the first step towards the mass production program.

★ ★ ★

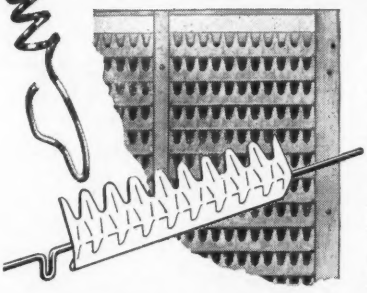
HITHERTO I have not found a great amount of co-operation

(*Please turn to page* 460)

Separates the Grain from the Chaff . . .

CLOSZ* Adjustable Sieves for Combines

made with KEYSTONE WIRE



Closz Adjustable Sieves can be quickly adjusted to any harvesting condition . . . eliminates the need for separate sieves for each crop. Adjusting feature permits instant cleaning without removing sieve from combine . . . reduces grain-waste and clogging. Used as standard equipment on combines and threshers . . evidence of Closz's outstanding features.

**Hart-Carter Company Webster City, Ia.—Peoria, Illinois*

Sieves are the heart of the grain-cleaning action in combines and threshers. They vibrate at high frequency to aid the cleaning action.

Each sieve slot in Closz Adjustable Sieves is hinged on special Keystone wire. The wire must be stiff to resist torsion, yet ductile enough for severe bending operations. The wire must also be abrasion-resistant to withstand wear due to vibration. And, good spot-welding qualities are required.

We are proud that special-analysis galvanized Keystone wire meets these exacting requirements. Let Keystone's wire specialists help solve *your* industrial wire problems.

KEYSTONE MUSIC SPRING WIRE

KEYSTONE STEEL & WIRE CO. PEORIA ILLINOIS

SPECIAL ANALYSIS WIRE for all industrial purposes

KEYSTONE STEEL & WIRE COMPANY
PEORIA 7, ILLINOIS

Outstanding Personalities of the Wire Industry

Mel Williamson Transferred from Spokane to Superintend Operations at Newark, Ohio

MEL WILLIAMSON, former Plant superintendent at the Shawinigan Falls rod and bar mill, and a member of the Wire Association has been elected to serve as Plant Superintendent of Permanente's Kaiser Aluminum rod, bar, wire and cable mill now being built at Newark, Ohio.

* * *

MR. WILLIAMSON joined the Kaiser organization a year ago and immediately began the long exacting study of rod mill layout, design and construction. Working with the Kaiser Engineers and calling upon his experience in the industry, together with a study of other domestic and foreign rod mill design, he resolved the plans for what is to be the worlds most modern and flexible aluminum rod mill. It embodies several unique principles of design and construction which eliminates many of the shortcomings of existing mills and includes other features of revolutionary nature which will permit greater production speed, flexibility and economy of operations.

* * *

Mel Williamson, Plant Supt. Permanente, Newark, Ohio.

* * * * * *

MR. WILLIAMSON was born at Big River, Saskatchewan. He attended the Pas High School in Manitoba, the Manitbo University at Winnipeg and received a degree in Engineering from Queen's University at Kingston, Ontario.

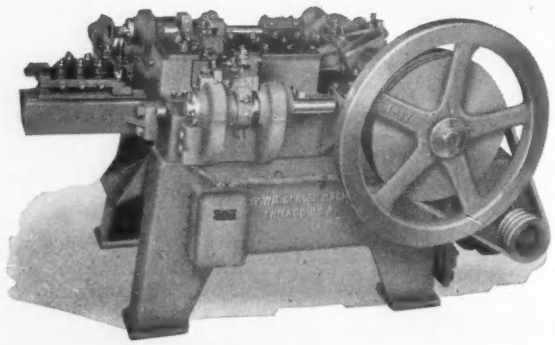
* * *

IN 1941 he accepted a position in Canada's rapidly growing aluminum industry. His first job was at the Kingston Works where he had the opportunity to gain production experience in aluminum sheet fabrication and the manufacture of aluminum extrusions and forgings.

* * *

AFTER two years at Kingston, Williamson moved to the rod and bar plant at Shawinigan Falls, Quebec. In less than three years he had worked up to the position of Plant Superintendent which he held until joining Permanente.

GLADER HIGH SPEED WIRE NAIL MACHINE



MACHINE ARRANGED FOR INDIVIDUAL MOTOR DRIVE

High tonnage output, and low maintenance costs, have resulted in Glader Machines being accepted as standard equipment in every large nail mill built in the United States in the past twenty years.

Glader Machines are operating in most of the wire producing mills throughout the world.

These machines are made in eleven different types and sizes. This enables us to cover the range of sizes of nails produced with the greatest efficiency.

For further information please address,

WM. GLADER MACHINE WORKS
210 No. Racine Ave.
Chicago 7, Illinois

Export Dept.: 122 E. 42nd Street, New York 17, N. Y.

Corbin Elected President of Standard Varnish Works

M. H. CORBIN became president of the **Standard Varnish Works** of New York and **E. E. Day,** president of the Standard Varnish Works of Illinois, both men succeeding J. Heath Wood, who was elected chairman of the boards.

★ ★ ★

MR. CORBIN has been with the company for eleven years and a vice-president and director for the last four years. After graduating from Lehigh University as a chemical engineer, Mr. Corbin held various important positions in the technical and sales branches of the paint and varnish industry and is an author of numerous articles on industrial finishes. He is a member of the Chemist Club, Advertising Club, Sales Executive Club, American Chemical Society, American Society for Testing Materials, and a Fellow of the American Institute of Chemists.

★ ★ ★

E. E. DAY has been with the company since 1920 and has served as a vice-president and director of the New York Corporation and executive vice-president and director of the Illinois company. He is well known in the industry—is a member of the Chicago Athletic Association, Illinois Athletic Club and the South Shore Country Club.

★ ★ ★

J. HEATH WOOD, who was elected chairman of the boards, has been president of New York for eighteen years and Illinois for twenty-four years. He is widely known in the industry—has been very active in the affairs of the National Paint, Varnish and Lacquer Association, serving as vice-president and on many committees. He began his paint career with the old Heath & Milligan Manufacturing Company.

★ ★ ★

OTHER new offfficers elected by the New York Corporation are W. B. Day, chairman of the executive committee; C. F. Lesch and H. H. Rittenhouse, Jr., vice-presidents; and in Illinois M. H. Corbin, J. P. Jordan and A. J. Kestly, vice-presidents, I. A. Cowen, secretary and treasurer. New directors are Carl Bauer of New York and M. H. Corbin, A. D. Robson and L. H. Jenkins of the Illinois company. A. D. Robson was re-elected vice-president and James S. Wolf, secretary and treasurer of the New York corporation. J. R. Strohm was re-elected a director of Illinois.

★ ★ ★

Haugh Appointed by Hydropress, Inc.

HYDROPRESS, Inc., New York, Builders of Heavy Hydraulic Machinery and Rolling Mills, has appointed **Carl E. Haugh** District Sales Manager of its Eastern and Mid-Western Divisions. Carl Haugh, who graduated in Mechanical Engineering, Commerce and Business Management from the University of Illinois and the Northwestern University, respectively, has had many years of experience in the Rolling Mill and Hydraulic fields.

New Vice-Presidents Elected By Harper Electric Furnace Corporation

AT the annual meeting of **Harper Electric Furnace Corporation,** 1455 Buffalo Avenue, **John Loudon** was elected vice-president in charge of Production, and **Edward G. Pierson,** vice-president in charge of Purchasing.

* * *

BOTH Mr. Loudon and Mr. Pierson have been identified with the Corporation for many years and have been instrumental in bringing its production to the present high level.

* * *

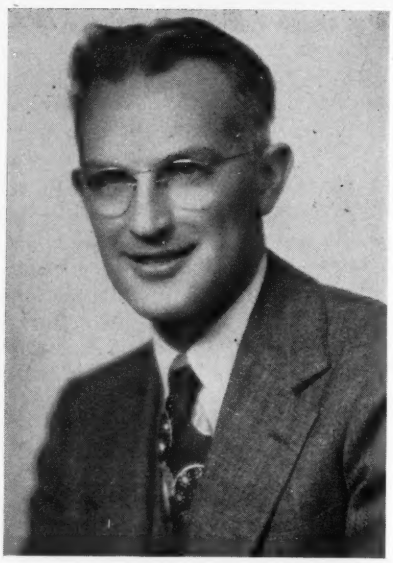
A SUBSTANTIAL increase in sales for 1948 was reported, and even with its own expanded manufacturing facilities, Harper finds it necessary to sub-contract to several plants in order to meet production schedules.

* * *

HARPER high temperature electric furnaces are widely used by America's foremost manufacturers for research and production in many industries. The corporation also manufactures electric kilns which have many applications in the ceramic field ranging from laboratories and classrooms in leading universities to large production kilns.

* * *

John Loudon, Vice-President Harper Electric Furnace Corp., Niagara Falls, N. Y.



Edward G. Pierson, Vice-President Harper Electric Furnace Corp., Niagara Falls, N. Y.

Hydraulically Operated **TRAVERSE REELS**

FOR FLAT WIRE AND NARROW STRIP

• The self-contained, compact SECO Traverse Reel has smooth, powerful hydraulic operation — at speeds from 150 to 600 feet per minute.

PERFECT SPEED CONTROL from zero to top running speed through flow control.

ACCURATE TENSION CONTROL through pressure regulation.

Built in sizes for coils weighing up to 600 lbs., for round or flat wire. Unit shown occupies floor space 24" x 42". Modifications in design and construction to meet specific requirements.

WIRE SPOOLERS

Single and Multiple Type

Speeds Up To 4,000 feet per minute

STEEL EQUIPMENT CO.

SECO 2890 EAST 83rd STREET CLEVELAND 4, OHIO

HARPER electric furnaces are distributed in all principal cities throughout America and throughout the world.

★ ★ ★

The Beryllium Corporation Elects New Officers and Directors

AT the Annual Meeting of the Stockholders of the **Beryllium Corporation,** held at Reading, Pa. on March 22nd, the following Directors were elected: Anita Berger, Otto T. Englehart, Maurice A. Hallam, Richard M. Quimby and Daniel T. Schwartz. The last named, Mr. Schwartz, was elected Chairman of the Board.

★ ★ ★

AT the same time, the following officers were elected: President, Otto T. Englehart; Vice-President, Matthew J. Donachie; Secretary, Richard M. Quimby; Ass't. Sec'y. and Treas., Anita Berger.

★ ★ ★

MR. DONACHIE, who is also Works Manager, is a member of the Wire Association.

★ ★ ★

Jack Williams to Represent Syncro on Coast

JACK P. WILLIAMS, JR., has been appointed California representative for Syncro Machine Co., Perth Amboy, N. J., with his office in San Francisco. He had formerly represented the company in the Chicago territory, and is well-known in the wire industry.

★ ★ ★

Jessop Steel Company Appoints M. K. Smith, Vice-President and Technical Director

MILES K. SMITH has been appointed vice-president and technical director of **Jessop Steel Co.,** Washington, Pa. He formerly was with Molybdenum Corp. of America in a technical sales capacity. Prior to that Mr. Smith was employed for many years by Latrobe Electric Steel Co. in the production of tool steels.

★ ★ ★

Scoville Mfg. Co. Appointment

R. L. DE BRAUWERE has been elected assistant vice-president of the **Scoville Mfg. Co.,** Waterbury, Conn. He continues to serve as assistant secretary of the company and as secretary and director of A. Schrader's Son, Inc., Brooklyn.

★ ★ ★

C. D. Patterson Appointed Purchasing Agent for Chase Brass & Copper

CHARLES D. PATTERSON has been appointed purchasing agent of Chase Brass & Copper Co., Inc., Waterbury, Conn., succeeding **Arthur G. Evans,** who retired after more than 46 years of service. Mr. Patterson has served as assistant purchasing agent since 1946.

★ ★ ★

Atlantic Steel Company Elects Officers

ATLANTIC STEEL CO., Atlanta, Ga., announces the follow-

The SPECIALISTS in
Wire - Straightening and Wire - Cutting!

Diameter Range — 1/16" to .005"

PRECISION - Our Motto

DON'T hesitate to call on us when you are confronted with wire-straightening problems involving close tolerances and absolute accuracy. For seventeen years we have specialized in straightening and cutting all gauges of fine wire, hard or soft, ranging in diameter from one-sixteenth of an inch down to five-thousandths of an inch. We employ gun-barrel accuracy in straightening lengths from one inch to ten feet or any fractional part thereof. Ends cut absolutely clean without burrs.

ASK ABOUT OUR UNEXCELLED FACILITIES FOR CLEANING AND POINTING WIRE ALREADY STRAIGHTENED AND CUT.

ALL TYPES OF WIRE...

- Nickel
- Stainless Steel
- Bronze
- Brass
- Copper
- Alloy Wire
- Music Wire
- Tag Wire
- Florist Wire

Write us today!

Manufacturers of the famous ARMA PAPER CLIP

PITTSBURGH CUT WIRE COMPANY
1112-20 GALVESTON AVENUE - PITTSBURGH, PENNSYLVANIA.
TELEPHONE: CEdar 4702

ing officers recently elected: **Charles F. Stone,** chairman of the board; **Robert S. Lynch,** president; **Wilbur F. Glenn,** vice-president **Howard B. Johnson,** vice-president-sales; **Joseph H. Girdler,** vice-president-operations; **Gilbert Purvis,** treasurer; **C. Howard Candler, Jr.,** secretary; **Robert S. Stradley,** assistant secretary and assistant treasurer; **Charles F. Williams,** general manager of sales; **R. E. O'Neill,** manager of the order department. **Marshall B. Hall** was elected to fill a vacancy on the board of directors.

* * *

Edwin S. Lewis Appointment

DONOVAN WIRE & IRON CO., Toledo, O., announces the appointment of **Edwin S. Lewis** as director of purchases for the parent and subsidiary companies. Since 1942 he has been Toledo district sales manager for Jones & Laughlin Steel Corp.

* * *

J. W. Vanderslice Appointment

JOHN W. VANDERSLICE has been appointed chief industrial engineer, **Oliver Iron & Steel Corp.,** Pittsburgh. He was formerly associated with the Pittsburgh office of American Associated Consultants, Inc. He has been affiliated with Jones & Laughlin Steel Corp., with Carnegie-Illinois Steel Corp. as an industrial engineer, and was production supervisor for Kaiser Steel Co., Fontana, Calif.

* * *

Aluminum Co. of America Appointments

DR. KENT R. VAN HORN has been named an assistant director of research, aluminum research laboratories, Aluminum Co. of America, Pittsburgh, and **Maurice W. Daugherty** was named chief of the Cleveland branch of the laboratories, succeeding Dr. Van Horn.

* * *

Roger F. Waindle Elected To A.S.T.E. Board

ROGER F. WAINDLE, General Manager of the Industrial Products Division of the **Elgin National Watch Company,** was elected to the Board of Directors of the **American Society of Tool Engineers** at the society's annual meeting in March. The A.S.T.E. is one of the largest of the engineering societies.

* * *

MR. WAINDLE is well known in technical circles for his lectures on sapphire tools and gauges and diamond abrasives for lapping and polishing.

* * *

L. W. Reeves Appointment

L. W. REEVES, assistant manager of the wire department, Sheet & Wire Division, Tennessee Coal, Iron & Railroad Co., Birmingham, has been appointed assistant manager of sales, Memphis, Tenn., district sales office.

* * *

THE NEW NO. 2A
"CHAIN-LINK" FENCE MACHINES
Mfd. by ARTHUR BLASHILL

The Climax of 50 years in Fence and Fence Machines.

The 2 A produces 30% to 50% more.

Takes minimum floor space, less power and maintenance and less labor. Fence is rolled-up just a step from the operator.

Accurate and rapid clutch action. Less than one second after forming one pair of "twin" spirals, to the start of next pair. Cut-off, advance and "knuckling" all automatic and within one second.

Our machines are built like machine tools. Fully ball and roller bearing equipped. Machine cut gears and parts of hardened alloy steels. Long life with smallest maintenance. An all-round superior machine.

Designed and built exclusively by

ARTHUR BLASHILL
WOODSTOCK,
ONTARIO, CANADA
(Formerly at Birmingham, England)

Hyatt Bearings Division Appointments

A. H. LUNDIUS has been appointed plant manager of the Hyatt Clark Township plant, near Harrison, N. J., of the Hyatt Bearings Division, General Motors Corp. He succeeds **J. C. Henny**, former plant manager, who retired Jan. 1.

★ ★ ★

Optimus Equipment Co. Appointments

OPTIMUS EQUIPMENT CO., Matawan, N. J., announces appointment of **Melville Morris** as executive vice-president and member of the board of directors. This appointment follows the merger of Midwestern Mfg. Co. of New York with Optimus Equipment Co., a subsidiary of Hanson-Van Winkle-Munning Co. **A. Otto Millen** has been appointed Middlewest district superviser, and **L. G. Evans Co.**, representative for Illinois, Indiana and Wisconsin.

★ ★ ★

Allegheny Ludlum Appointments

MELVIN C. HARRIS has resigned as vice-president in charge of production, Allegheny Ludlum Steel Corp., Pittsburgh. **C. B. Pollock**, production manager, is in charge of production for the company. Mr. Harris joined the company in 1915 and later served as plant manager and manager of production. He was elected vice-president in 1946. Mr. Pollock has been associated with Allegheny-Ludlum since 1932 and has been manager of production since 1946.

★ ★ ★

CF&I to Get Billet Furnace

COLORADO FUEL & IRON CORP. has placed an order for a new billet heating furnace for the rod mill at its Pueblo, Colo., plant. The contract with the Rust Engineering Co., Pittsburgh, calls for a double-fired unit with a top outlet for waste gases. Designed for a maximum temperature of 2500°F, the furnace will heat 60 tons of 24-ft. billets per hr. Effective heating length will be 65 ft. Inside width is to be 26 ft. and outside length 73 ft.

★ ★ ★

Raymond F. Russell

RAYMOND F. RUSSELL, Vice-President and Treasurer of **Sleeper and Hartley, Inc.**, Worcester, Massachusetts, passed away on March 6, 1949.

★ ★ ★

MR. RUSSELL had served his company for twelve years and his passing is deeply regretted by his associates and his friends in the wire industry.

★ ★ ★

SLEEPER AND HARTLEY are well-known throughout wire circles as manufacturers of a wide variety of wire machinery, but are chiefly noted as pioneer developers and manufacturers of spring making machinery.

★ ★ ★

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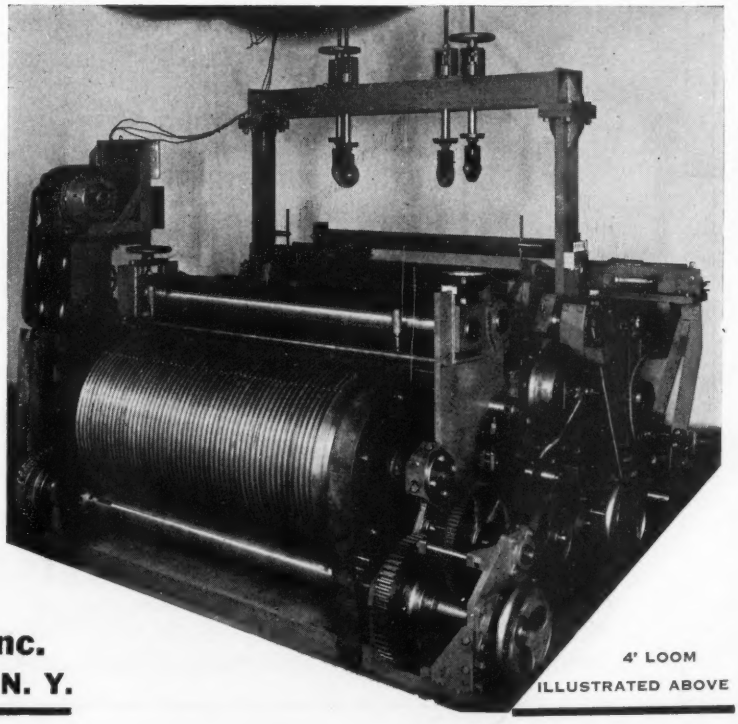

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A Review of Recent Wire Patents

NO. 2,463,039, ELECTROPLATING COPPER CONTAINING COATING, patented March 1, 1949 by George W. Kellog, Flint, Mich., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware.

A corrosion-resistant surface is provided for ferrous metal comprising an electrodeposited layer of .0001" to .0005" thickness of copper, an electrodeposited combined layer of .0002" to .0005" thickness of 70% of copper and 30% zinc, and an outer electrodeposited chromium layer, with all being heated to about 800° to 950° F. for 10 to 30 minutes.

★ ★ ★

NO. 2,463,079, ATTACHABLE BRACE AND GARMENT CONNECTOR, patented March 1, 1949 by Paul Albrecht, Astoria, N. Y.

This device is formed from a single length of rigid wire, bent into a W-shape with three hooks at the ends and the center.

★ ★ ★

NO. 2,463,590, WEIGHT-CARRYING CABLE, patented March 8, 1949 by Armais Arutunoff, Bartlesville, Okla.

The cable comprises a central tapered core and strands of tapered wires around this tapered core, every length of each of the wires being progressively and continuously reduced in diameter from the upper to the lower extremity of the wires.

★ ★ ★

NO. 2,464,455, ELECTRICAL INSULATION, patented March 15, 1949 by Wallace Bentley MacKenzie, Yonkers, N. Y., assignor to Phelps Dodge Copper Products Corporation, Dover, Del., a corporation of Delaware.

About the wire conductor is a hydrocarbon plasticized, non-flame vinyl composition.

★ ★ ★

NO. 2,464,464, METHOD AND APPARATUS FOR FEEDING STRIP, patented March 15, 1949 by Frederick K. Schefe, Gary, Ind., assignor to Carnegie-Illinois Steel Corporation, a corporation of New Jersey.

For feeding coils of metal strip the inventor provides an uncoiler for supporting a coil to be fed, a movable carriage, a pair of spaced apart coil supports mounted on this carriage, a device for moving the carriage longitudinally of the path of the strip to bring the supports selectively into line with the uncoiler, means for raising and lowering the coil supports to bring the axis of the coils supported thereon into line with the axis of the uncoiler, and a device for moving this uncoiler to and from the coils supported on the supports.

★ ★ ★

NO. 2,464,568, ELECTRICAL COIL INSULATED WITH THERMOPLASTIC PARTICLES AND THERMOSET POLYMER, patented March 15, 1949 by Edward J. Flynn and Frank J. Lasak, Schenectady, N. Y., assignors to General Electric Company, a corporation of New York.

The insulation for this wire coil comprises particles of a thermoplastic polymeric material intimately associated with an insoluble and infusible product of polymerization of ingredients including a polymerizable unsaturated alkyd resin and a liquid monomer containing an ethylenic linkage that is copolymerizable with this alkyd resin.

★ ★ ★

NO. 2,464,665, SPRING SUPPORTED FIGURE, patented March 15, 1949 by Gustaf Anderson, Worcester, Mass.

An ornament for Christmas trees or the like is provided consisting of a relatively long exposed wire coil spring, a

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support at one end thereof from which the spring depends, and an upturned end at the other end of the spring, this upturned end being located within certain of the coils, and a figure (such as a bird) mounted on the upturned end to be located within the coil spring as a cage.

★ ★ ★

NO. 2,464,860, WIRE STRAND MACHINE, patented March 22, 1949 by Richard Duane Green, Trenton, N. J., assignor to John A. Roebling's Sons Company, Trenton, N. J., a corporation of New Jersey.

In this twister, a number of wire carrying spools are rotatable on and concentric with a spool carrier, which also mounts a twisting head carrying a number of spool wires arranged to twist the wires into a twisted strand, then received by a flyer and carried around the spool carrier.

★ ★ ★

NO. 2,464,888, STRETCHING MACHINE FOR FLATTENING METAL STRIPS, patented March 22, 1949 by John Burley Picton, Wolverhampton, England, assignor to Joshua Bigwood & Son, Limited, Wolverhampton, England.

The metal leaving the uncoiler is formed into an elongated loop above the bed of the machine, and both ends of the strip are engaged in a single gripper, while the opposite end of the loop is engaged by a drum.

★ ★ ★

NO. 2,465,105, OXIDE INSULATING COATING FOR NICKEL CHROMIUM RESISTANCE WIRE, patented March 22, 1949 by Roberto Levi, New York, N. Y., assignor, by mesne assignments, to Philips Laboratories, Inc., Irvington-on-Hudson, N. Y., a corporation of Delaware.

The coating is provided by electrodepositing a copper layer on the wire having a thickness of the order of microns, drawing the wire to reduce the thickness of the copper layer to a uniform copper layer having a thickness of about 0.2 of a micron and heating the copper coated wire in an oxidizing atmosphere to a temperature greater than 1026° C. and less than 1080° C., thus forming an insulating coating of oxides of chromium, nickel and copper.

★ ★ ★

NO. 2,465,296, METAL CHELATE STABILIZED ORGANIC SILICON COMPOSITIONS AND PRODUCTS THEREOF, patented March 22, 1949 by Jack Swiss, McKeesport, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania.

A wire conductor is provided with an insulating coating comprising polmerized silicon compound and a metal chelate.

★ ★ ★

NO. 2,465,333, SPRING ASSEMBLY, patented March 22, 1949 by David I. Levine, Swampscott, Mass., assignor to Spring Unit Development Co., Lynn, Mass., a partnership.

Wire coil spring units are secured together by wires tying convolutions of units in one row to units in another row, each tie wire having offset loops spaced longitudinally therealong. U-shaped clips are provided at the junctures of the tie wires with the units which they tie, the legs of each of the clips enfolding a portion of a convolution of a unit in one row, both legs of each clip being apertured, and an offset loop of a tie wire extending transversely from one side of each clip through these apertures below the enfolded convolution portion and being crimped around a portion of a convolution of an adjacent unit in the same row to interlock at each of the junctures of these two convolutions, tie wire and clip.

★ ★ ★

NO. 2,465,867, METHOD AND APPARATUS FOR RIPPING AND POLISHING WIRE DRAWING DIES, patented March 29, 1949, by Guiseppi Gargano, New Haven, Conn., assignor to The American Steel and Wire Company of New Jersey, a corporation of New Jersey.

Ripping and polishing is effected in one continuous operation, usually by the use of one abrading tool.

★ ★ ★

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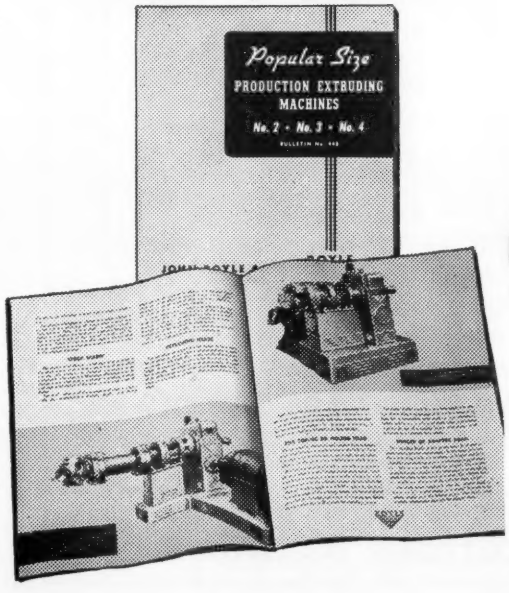

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(*Continued from page 427*)

length. One line handles large heads and the other small. Heads slide out of the nailers onto conveyors to arrive next at the reel borers, machines that can drill an arbor up to 6" in diameter and as many as 24 holes simultaneously in less time than it takes to describe the operation.

★ ★ ★

ANOTHER conveyor carries the heads to a band saw machine that cuts them to a proper diameter and circular size, after which operation another machine bevels the edges and routs a recess for the drum stays. Other special machines in the line will make label recesses for such heads as require them; otherwise, they are by-passed. Following this, reel heads go directly to the assembly room or through a paint booth and into an infra-red drying oven, if an order calls for paint. Conveyors at all points minimize handling and greatly speed operations.

★ ★ ★

THE busy storage assembly and shipping room is provided with such automatic accessories as air hammers, that run the nuts onto the bolts quickly, uniformly and tightly. This saves time, physical energy, and does a better job. As fast as reels are completed, they are loaded for transportation to

Fig. 7. General view of the storage, assembly and shipping room.

customers. On orders where reels are to be shipped knocked-down, the loading of the necessary component parts is done without going through the assembly operation.

★ ★ ★

TO give some idea of production flow, it is interesting to note the speeds that have been attained. In the larger range of sizes, an average of 100 heads or 50 reels per hour are completed; in the intermediate sizes, 200 heads or 100 reels can be made; and in the small sizes, 500 heads or 250 reels are turned out consistently.

★ ★ ★

WORK moving through the plant, either for standard items or special orders, carries through smoothly. The system is designed for flexibility, so that the number and spacing of holes, the diameters of drums or flanges, the arrangements for painting or stenciling and so forth, can all be altered or re-routed in short order with small loss of production time.

★ ★ ★

IN order to service mechanical equipment properly, a model machine shop, outfitted with welders, millers, lathes, planers and other equipment, keeps tools sharp and machines in repair. Complete reconditioning jobs and alterations of mechanical features of existing equipment can be performed here.

★ ★ ★

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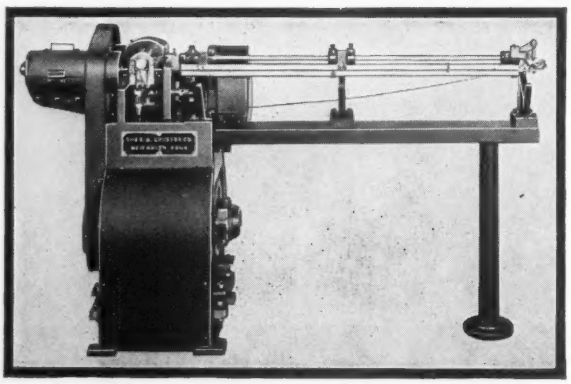

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WIRE STRAIGHTENING AND CUTTING MACHINES

in keeping the cost of reels down to a point of reason through the application of straight-line production principles would not be complete without a tribute to their imagination, willingness to try new ideas and to invest their hard-earned cash in whatever equipment or changes in layout that look to them like a step that will enable them the better to serve the wire industry.

★ ★ ★

ONE of the interesting developments of the business in more recent years is a fleet of trucks that regularly ply the highways between Hazardville and customers' plants within a radius of a couple of hundred miles—a service that in time of urgent need has proven its value. One might argue that a mill should never get out of reels, but it does happen occasionally, and a special over-night shipment has more than once saved a shut-down.

★ ★ ★

A New Theory of the Plastic Deformation in Wire-Drawing

(*Continued from page 417*)

On the other hand the die pressure decreases, but only slightly. This suggests the universal approximation $q' \cong q$ so that:

$$t' \cong (1 + \mu \cot \alpha)\, t, \quad \ldots\ldots\ldots\ldots (10)$$

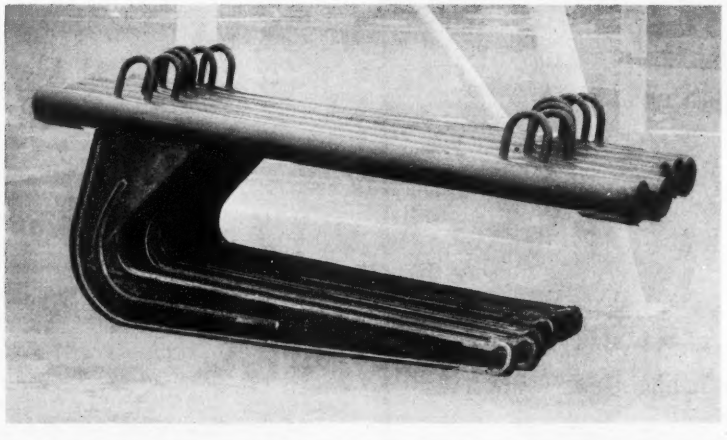
where q and t are the die pressure and drawing stress for the die when smooth. This equation should also be valid to a similar approximation for a work-hardening material; in this case t represents the drawing stress for a smooth die corrected for hardening, as described in the previous section.

★ ★ ★

EQUATION (10) has, of course, been used frequently to estimate coefficients of friction from measurements of the drawing load, but its accuracy has hitherto been a matter of conjecture. Since the values of the coefficient of friction found in drawing practice are usually smaller than 0.1, the formula (equation 10) should be not more than 5% in error in the worst case (i.e., for small die angles), and generally much less. An additional advantage of using this formula is that the sense of the error is known, the drawing stress being always slightly overestimated. Sachs and more recent workers have taken account of friction in a more complicated way, but their theories all suffer from the defect of assuming the deformation to be homogeneous extension.

★ ★ ★

FOR a given reduction the frictional contribution to the drawing load decreases as the die angle is increased; on the other hand the contribution from the non-useful work increases. For a given reduction and coefficient of friction there will, therefore, be an optimum die angle corresponding to minimum drawing load. We can use equation (10) and Fig. 5 to find this for the ideal material. Figures 9 and 10 show the drawing stress plotted against the die half-angle for a series of reductions, the coefficient of friction being 0.05 and 0.10, respectively. The minimum is rather flat and the optimum angle is not very well defined. In other words, from the



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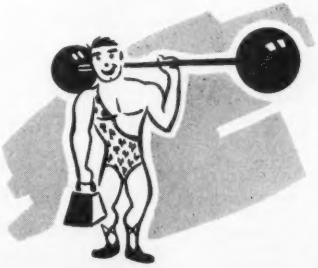

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point of view of drawing practice, the optimum conditions are fortunately not especially critical. When $\mu = 0.05$ the variation of the optimum half-angle $\bar{\alpha}$ with fractional reduction of area r can be closely represented by the relation:

$$\bar{\alpha}^\circ = 40r; \; r \leq 0.5 \quad \text{.....(11)}$$

When $\mu = 0.10$, the optimum angle is greater, but only by about 10%. The optimum angle is somewhat less for an annealed metal than it is for a work-hardened metal; precise values for any given stress-strain curve can easily be found, if required, by applying the correction for hardening in conjunction with equation (10) and Fig. 5. The increase of the optimum angle with increasing reduction has been experimentally observed by Linicus and Sachs,[10] and by Weiss[11] who fitted his data by the relation $\bar{\alpha}^\circ = 30r$ (coefficient of friction not known).

★ ★ ★

IT may be seen from Fig. 5 and equation (11) that when drawing is done under the optimum conditions, the drawing load calculated by the present theory does not differ by more than a few per cent from that given by the homogeneous extension theory of Sachs, except at reductions of less than, say, 15%. Sachs' theory cannot, of course, predict what the optimum conditions are.

★ ★ ★

The Deformation in Drawing

THE distortion of a square grid, supposed ruled on a longitudinal section of the wire, has been calculated for the plane-strain model with an ideal material, a smooth die, a half-angle of 15°, and a reduction of 34.1% (see Fig. 11). This reduction corresponds to the special configuration represented by equation (3). The calculation was based on equations (2) of the paper by Hill.[5]

★ ★ ★

IN the Figure a transverse line of the grid is on the point of entering the die. The longitudinal lines in the drawn metal are still spaced equally, as a simple consequence of the steady conditions. The deformed transverse lines are also straight except over the section which passes through the curved part of the entry slip-line. The cusp on the centre line is a direct result of the tangential velocity discontinuity across the entry and exit slip-lines. It is apparently characteristic of plane-strain conditions. In the actual situation of axial symmetry the hoop strain near the axis probably prevents the formation of such a cusp, and in fact it is not generally observed. It may be shown that the total included angle 2ψ of the cusp is such that:

$$\cot \psi = 4 \sin^2 \bar{\alpha} \quad \text{.....(12)}$$

in the special configuration. The formula for the slope of the straight section of the transverse lines is too complicated to be worth giving here. The drawing stress for $\bar{\alpha} = 15°$ and a reduction of 34.1% (see Fig. 5) is very close to the stress corresponding to uniform extension. The drawing process is thus in this instance a remarkably efficient means of producing the desired reduction.

★ ★ ★

Acknowledgment

THE authors are indebted to the Chief Scientific Officer, Ministry of Supply, for permission to publish this paper.

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★ ★ ★

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★ ★ ★

Portsmouth Steel Corporation

(Continued from page 424)

(B) New equipment which has been installed consists of a battery of high-speed continuous coarse wire machines, covering a draft range of three to seven drafts, and a battery of continuous intermediate wire drawing machines. These latter machines are seven-hole machines and are capable of drawing all sizes and types of high carbon wire normally furnished on 16-inch block size. New fine wire drawing equipment is now in the process of being built and installed.

★ ★ ★

ALL new equipment has been installed in the mill in accordance with a new plant layout designed to utilize the most modern concepts of wire drawing and handling. Existing equipment is being relocated as quickly as possible to conform to this master plant layout. When the plant is completed, the mill will conform to a straight-line production setup requiring a minimum of handling and transportation from rod rolling to finished wire shipping.

★ ★ ★

THE mill had inadequate galvanizing facilities when acquired by the Portsmouth Steel Corporation. In order to round out and complete the line of galvanized wire that can be furnished, additional coarse wire galvanizing units have been added which are capable of both heavy coating and tight-wiped galvanizing. In addition to these galvanizing units, fine wire galvanizing units have also been added. These units are capable of producing wire on either 8-inch or 12-inch blocks.

★ ★ ★

(C) The nail mill has been completely revamped and regrouped, resulting in greater efficiency of both men and machines. All barbed wire machines have been rebuilt and their productive capacity materially increased.

★ ★ ★

CONSIDERABLE attention is now being given to the methods of bundling, storing, and shipping wire. Modern Signode bundling machines have been installed and facilities have been built to accommodate the increasing number of truck shipments being made. Wire is now being stored on pallets and is moved from storage to shipping by fork and lift trucks.

★ ★ ★

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THE foregoing comments are a brief resumé of the work that has been and is being done to convert this mill into an efficient productive unit. It can readily be seen that when the program is completed, the Portsmouth Steel Corporation will be eminently prepared to furnish all types of low and high carbon wire, in coarse, intermediate, and fine sizes. The incorporation of the most modern methods in drawing and handling facilities assures the production of these items to a high quality standard with maximum efficiency.

★ ★ ★

Aluminum Wire — Part III

(*Continued from page* 423)

traces of soap on the wire may cause corrosion and annealing troubles. For these reasons, it is not to be recommended. All the same, I have known it to be used, but this was always under conditions of temporary improvisation, when other more suitable lubricants were not available.

★ ★ ★

Conclusions

THE above, I think, covers the main types of lubricant used in aluminium wire drawing. Of course I should say that oils are at present much the most widely used, emulsions next, with petrolatum of only small importance. In the forthcoming era of high speed production, however, the emulsions may become the most important type because of their efficiency as coolants.

★ ★ ★

DISCUSSION ON LUBRICANTS

Mr. Brooke

SOMETIME ago, we used a lubricant which consisted of a very fine grade of french chalk mixed with a light oil. Could Mr. Perry give us his opinion of this type of lubricant?

★ ★ ★

Mr. Perry

IT is quite common practice to introduce fillers such as french chalk, talc or mica in lubricants for bar drawing and tube drawing. In wire drawing, on the other hand, such fillers are avoided as they tend to block up the circulation systems and the die holes. This statement applies to aluminium, as to other metals.

★ ★ ★

Dr. Goodacre

WHAT is the effect of an etched surface upon the lubrication of aluminium and what strength of acid should be used?

★ ★ ★

Mr. Perry

I THINK that etching the surface would have no appreciable effect upon lubrication. Broadly speaking, the lubrication of aluminium wire is a simple matter, because you have not got the same high drawing pressures to deal with as in the case of steel, for example. We all know that in drawing steel wire very high pressures are set up in the die, and that the special surface represented by the sull coat and lime plays an important part in carrying the dry soap lubricant right into the throat of the die. Without this action, the high pressures would lead to scoring. The case of aluminium is quite different, because pressures are lower and liquid lubricants are used.

★ ★ ★

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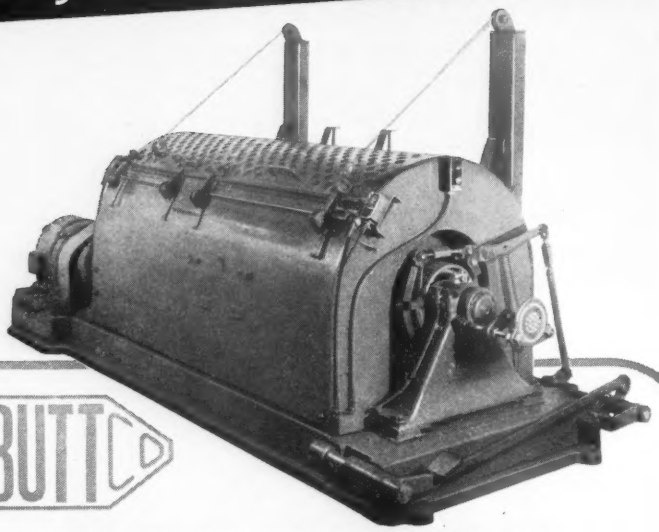

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Dr. Goodacre

WHAT steps would you advise for the removal of sulphonated oils from the surface of aluminium?

* * *

Mr. Perry

SULPHONATED oils, being emulsifiable, can usually be removed quite effectively by means of water and I do not know that any special technique is necessary with aluminium.

* * *

Mr. Wells

IT appears that whilst mineral oils are most efficient lubricants for aluminium wire drawing, emulsions are likely to take priority in high speed drawing because of their superior cooling properties. According to Mr. Perry, soap, which is the standard method of putting an oil into emulsion, causes corrosion. Has he any information with regard to the use of non-polar emulsifying agents, and has he any knowledge of petroleum sulphonate being used for this purpose?

* * *

Mr. Perry

PETROLEUM sulphonates are now widely used in emulsifiable lubricants such as soluble oils, and such lubricants are used for drawing aluminium wire. Of course, using emulsifiers of this type does not remove all danger of corrosion; if the pH of the emulsion is unsatisfactory corrosion may still occur. Again, the petroleum sulphonates, like the ordinary fatty soaps, can cause staining during annealing by leaving non-volatile residues on the metal. We therefore often find it necessary to limit the amounts of such emulsifiers in lubricants designed for metal working.

* * *

Mr. Peter Smith

I THINK that the cooling powers of lubricants raises the question of which is the most suitable type of machine for aluminium drawing. On wet drawing plants, the lubricant has the dual function of cooling and lubricating. The storage type, non-slip machines which we use for drawing steel wire are equipped with a water cooling system for the dies and the blocks, and there is a considerable cooling period between each drawing stage. I am of the opinion that with this latter type of machine, the mineral oils might still have a future.

* * *

Mr. Perry

I THINK that your supposition is probably quite correct, and we who supply lubricants are always very interested to hear what the wire drawing industry has to say on such points, because we necessarily have to follow the trend of the industry. If a certain type of machine is preferred for any reason, we then have to supply lubricants suitable for that type.

* * *

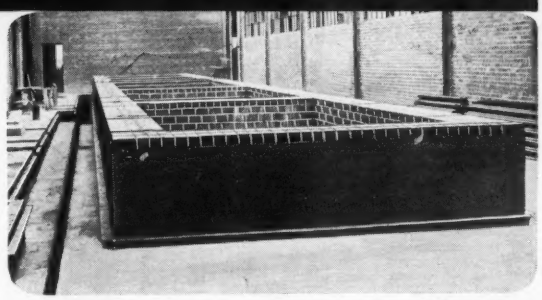
Mr. Bedford

IS the aluminium wire surface, as produced with the use of a mineral oil as the lubricant, found to be sufficiently attractive to customers, without the use at the last hole of some special lubricant

PRODUCTION HOLD-UPS

due to corrosion caused "down time"

CAN NOW BE DONE AWAY WITH



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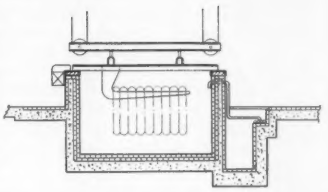

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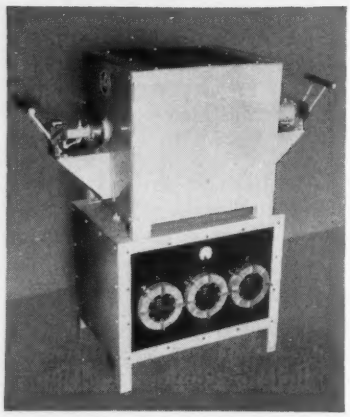

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Write for Bulletin No. 1148.

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Representatives in principal cities.

for the purpose of improving the wire's appearance.

* * *

Mr. Perry

IN my experience, the answer to your question is yes. We supply a fair quantity of such oils (thick oils for heavy wire and thin oils for fine wire) and our customers appear to be quite satisfied with the surface finish obtained. These oils appear to be perfectly adequate for the lower drawing speeds. According to my information, this is also found to be so in the United States.

* * *

Mr. Hird

WE have discussed dry lubricants, mineral oils and emulsions. We in the steel wire trade have used successfully for some time, a lubricant which is described to us as being a powdered oil. Although being similar in appearance to soap powder this lubricant is not a soap—it cannot be taken home for washing-up for instance. Might not such a product go a long way towards providing a dry lubricant which does not present the disadvantages of soap?

* * *

Mr. Perry

I AM afraid that I have never heard of a "powdered oil". It seems likely that this product must either be a fat, a wax or a soap. Such products could of course be powdered up, but the term "powdered oil" is completely new to me. But whatever the product may be, and however successful as a lubricant, being a solid it would not have any cooling power and in this respect would be similar in performance to petrolatum.

* * *

Eastern Carbide Made Direct Distributor by Engis Equipment Co.

THE **Engis Equipment Company,** 431 So. Dearborn St., Chicago 5, Ill., manufacturers of "Hyprez" diamond compounds for finishing and lapping carbide dies and tools, has announced the appointment of **Eastern Carbide Corporation,** 909 Main St., New Rochelle, N. Y. to handle "Hyprez" compounds as exclusive direct distributors for the State of New York, Northern New Jersey and all of New England. Walter A. Ruppel, President of Eastern Carbide Corporation, reports that customers are enjoying considerable savings in time and costs through the use of these ready-prepared compounds.

* * *

EDITOR'S NOTE

The second in the series of articles by Dr. Kenyon will appear in the June Issue of Wire and Wire Products.

Wire Drawing Lubricants

(*Continued from page* 410)

aluminum wire successfully with a water solution and in other places we have had trouble, mostly due to this lack of slip, we believe. But this does not deter us from the belief that we will draw aluminum rods and wire with a water solution. We consider aluminum and to some extent copper and bronze as sort of a greasy metal and it is here especially where we believe in the idea of reducing surface tension, so that the solution will apply to the metal in a continuous film. We also do not believe that you have to have a dirty machine or dirty dies to draw copper wire. We remember in checking with a mill as to how a certain lubricant was going, a foreman lifted the hood of the machine, looked at the capstans and said was running all right. He was basing his conclusion on the fact that there was a heavy coating on the capstans. At another plant an Engineer told me that when their machines seemed to be cleaner than usual, they looked for trouble. At another plant

they tried a water soluble solution on aluminum rods unsuccessfully, altho this could have not been all the fault of the solution. When they added some of the compound to the oil they were using, they found that the dies were cleaner and both the die man and the owner thought that they would get better results, altho they had not been running long enough to have anything definite. The foreman in this particular plant informed us that he had not changed compounds for thirty years and said that what was good enough for his grandfather was good enough for him. And here is a point we would like to stress; we think that you as the user and we as the manufacturer are on the same team and that if the manufacturer of lubricants is going to make better lubricants he can only do it with your help and your cooperation. We cannot tell in our laboratory if a certain lubricant is good. We only know or at least we are supposed to know the basic principles but we can't tell for sure until it has been tried out under actual mill conditions in your plant. So when we offer something and it seems that we might be asking you to run our tests for us, it is really about all we can do. If it is good, you are benefited and others are benefited. If something else is tried out in another mill and it is good, then that mill will be benefited and so will you and so on. And to our mind this is the only way we are going to arrive at that goal for which we are all striving, and that is better results.

★ ★ ★

SO on non-ferrous metals, a dirty machine or dirty dies are not necessary. We do not believe it is necessary to use as heavy a solution as is commonly used nor do you have to have as high a free fat content, for with less free fat and less hydralysis alkali, less copper soap will be formed. On fine copper wire a potassium soap of some kind is used, it is now possible to get this soap so that it will not suds, which often is bothersome, especially when a new tank is made up. It is also possible now to get a soda soap, a dry soap, for this work and this will make

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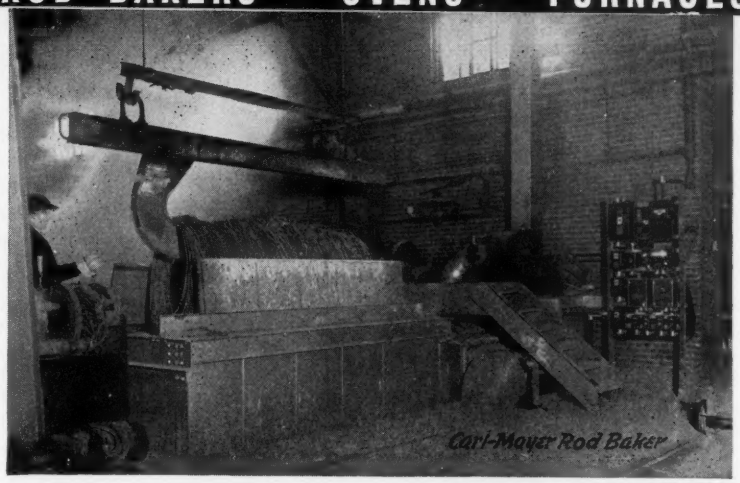

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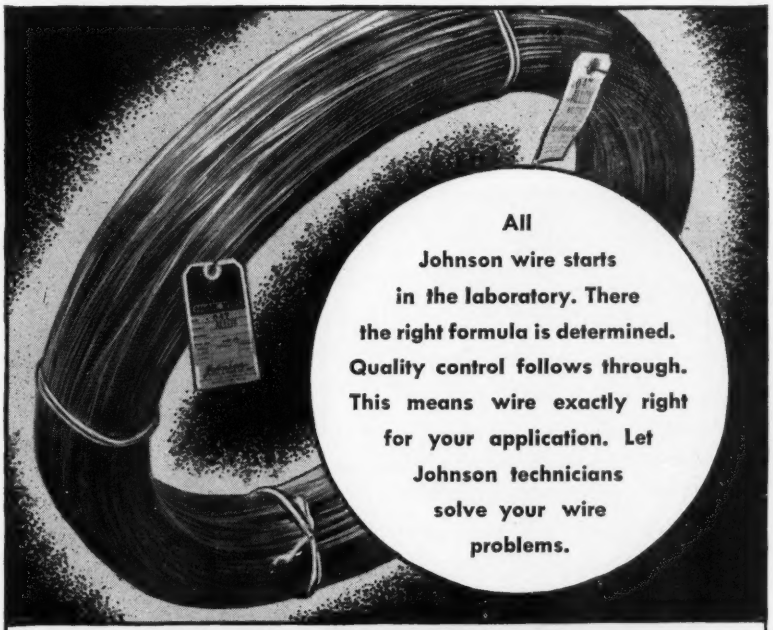

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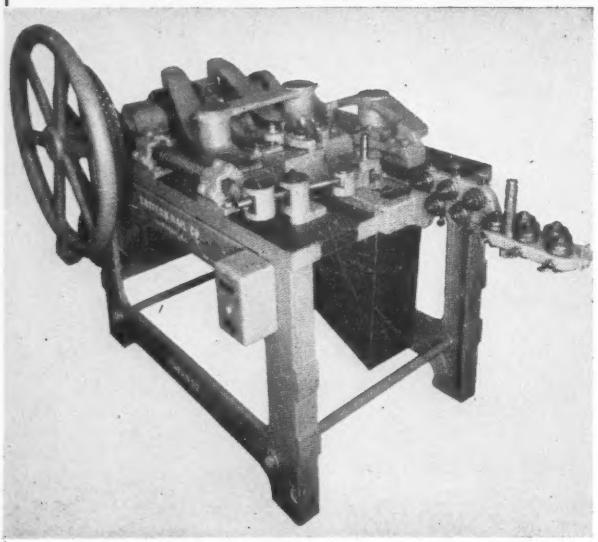

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for a cleaner wire and will be more economical as you will not be paying for water or paying freight on water. This dry soap can now be obtained, that will not suds.

★ ★ ★

IT could also be that some special coating might be used on copper rods; one that would take off the copper oxide and also form a coating that might be beneficial to drawing. We believe this, but we can't prove it. So you see if we don't know too much about drawing non-ferrous metals, you will have to admit that we do have some ideas and who knows, they might turn out to be actualities. With some knowledge of things going on, we would like to emulate a practice of a well known Washington commentator and make a few predictions, that is, if we can do this without having persons in high places calling us some rather indelicate 'three letters'.

★ ★ ★

Predictions

SO we predict, that spring wire and bolt stock will be drawn without lime on the rods, with a satisfactory finish on the wire and a better coating for the bolt making machines. We will go farther and say that bolt stock will be drawn with the coating and lubricant in one compound and this will be used in water solution and the rods dipped in the solution and eliminate entirely the use of soap in the die box. In one plant this is being done at the present time and so far has been very satisfactory and as far as can be determined at this early stage, it has proven satisfactory on every type of bolt this Company manufactures. More may be known about this by the time this paper is presented. Also we predict that practically all wire will be drawn with a dipped coating, with no soap in the die box at all. On special wire such as one or two hole bright, some special lubricant might have to be used, altho, if there is sufficient tank capacity in the cleaning house, this may not be necessary. In cases where there is not sufficient tank capacity and where dipping does

not seem feasible, we predict that some other mechanical means will be used to greatly reduce the amount of wasted soap. **WE HOPE THAT WE ARE RIGHT.**

★ ★ ★

WE have endeavored to present in as comprehensive a manner as possible in a single paper some of the aspects of drawing wire from the lubricating standpoint, and a little picture of what your lubricant manufacturer is trying to do, but we feel there is a lot more to be known and feel at times that we are rather inadequate and that perhaps we are not keeping up with the wire industry as a whole. However, some progress is being made and we believe there will be new developments that will have a very important effect on drawing wire more efficiently and at less cost. As we stated in the beginning, it is rather difficult to present such a paper without mentioning ourselves too much and if we have done so, we hope you will try and overlook it.

★ ★ ★

Electrical and Allied Developments of 1948

(*Continued from page* 428)

in product and reduction in processing cost was the experience of a manufacturer of calculating machines. He found that freedom from distortion with induction heating methods eliminated grinding operations previously required after conventional heat-treatment methods. There resulted a cost reduction of 12 per cent and an improved product.

★ ★ ★

A ROLLER-HEARTH furnace is accomplishing in one operation what previously required seven. Heretofore, pickling was the only method known for treating and preparing metal surfaces for porcelain enameling; today, the furnace turns out a product surface not only equal to that obtained by pickling but in some ways superior.

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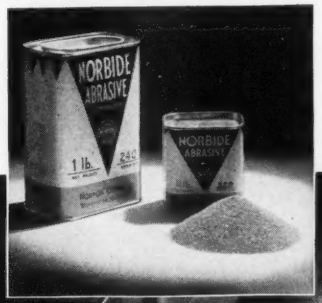
NORBIDE Abrasive: Effective, Economical



This abrasive—second only to the diamond in hardness and 150 times less expensive—does an efficient job of cutting and semi-finishing cemented carbide wire drawing dies.

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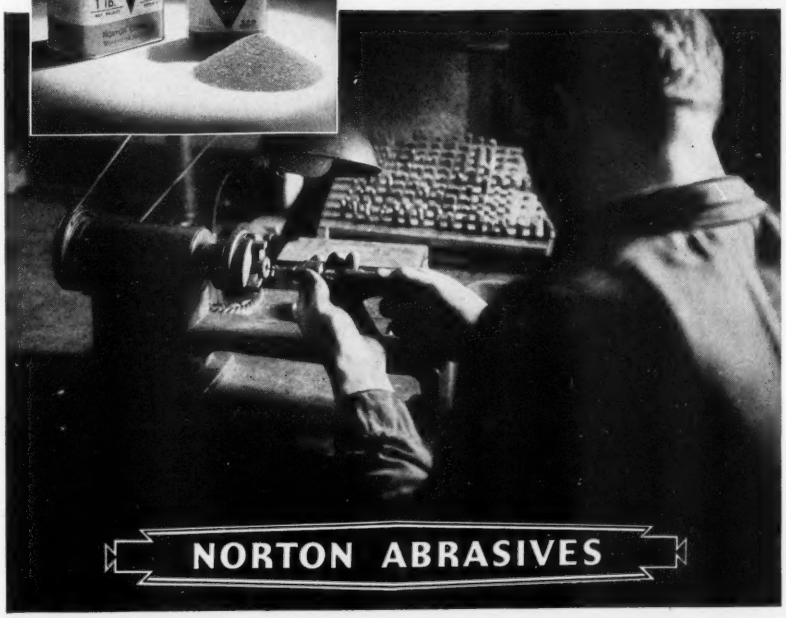

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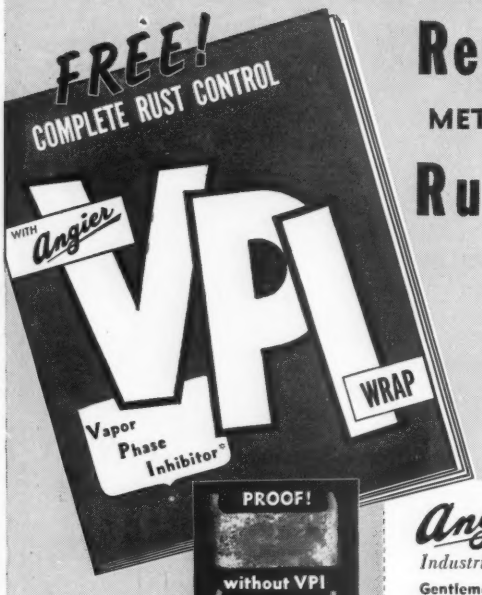

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Welding

A MAJOR trend during 1948 was the use of low hydrogen covering for arc-welding electrodes to facilitate the fabrication of "hard-to-weld" metals. Among such metals are high-carbon steels (0.4 carbon and higher), sulphur bearing steels (free machining), high tensile steels of high hardenability, and weldments where high impact strengths are desired. In the field of new equipments, probably the most interesting trend has been to the widespread use of welding generators on commercial jeeps.

★ ★ ★

TO reduce kva-demand where power supply is limited, a three-phase resistance-welding control of the frequency-changer type was developed. The life of electrode tips is increased 5 to 10 fold when welding aluminum alloys by using a "slope control," an attachment for use with standard resistance welding control which has electronic heat control. Preliminary tests also indicate advantages in the use of such equipment for welding heavy-gauge steel and for projection welding.

★ ★ ★

Rubber and Plastics

TENSIOMETERS, so successfully applied in the steel industry, were introduced into the rubber industry with the application of two equipments for measuring tire fabric tension in the treating and calendering process.

★ ★ ★

TWO 400-hp, 100 yard per minute, high-accuracy plastic calenders installed during the year are the largest and fastest yet designed.

★ ★ ★

Steel and Metals

A NEW tool for the steel mill—the magnetic amplifier—may prove as important to the progress of the steel industry as has the amplidyne. It has no moving parts or filaments. A d-c saturable reactor permits a small input signal to control a relatively large output signal. Several input or control windings may be used in a

manner similar to the control fields of an amplidyne. Under proper conditions, the amplification and speed of response are comparable to that of the amplidyne. The magnetic amplifier is expected to take the place of the amplidyne or the electronic amplifier in some regulating circuits, and to be applied in conjunction with the amplidyne in many others.

★ ★ ★

EXISTING hot-strip mills were being revamped, and new mills of both the continuous and reversing type being built. Four tandem cold-strip mills with individual generators went into production. Some of the largest reversing cold-strip mills ever designed are now being built.

★ ★ ★

IN keeping with developments in other cold rolling mills, temper pass mills are becoming larger and faster; a 42-in., 5000-fpm, two-stand mill is being built.

★ ★ ★

ONE of the fastest existing electro-tinning lines has been given even greater capacity for some classes of product by the addition of 300 kw of 9600-cycle induction heating for flow-brightening.

★ ★ ★

Electron Tubes

A NEW receiving tube permits the design of a two-stage amplifier with a single tube. It is a twin-triode voltage amplifier, specially designed, processed, and tested for very low values of noise, hum and microphonics. Two new subminiature receiving tubes, including a radio-frequency pentode and a double triode, designed and developed for the Air Force, are of such small size and outstanding performance as to make them of great technical interest.

★ ★ ★

RADAR equipment is subject to stringent operating conditions. Cathode-ray tubes must function aboard ships or planes and must provide an easily read signal 24 hours a day. For such use, a tube was developed with a screen sur-

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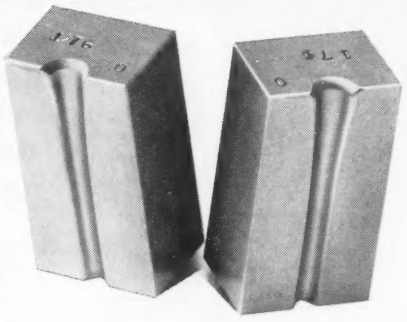
SJOGREN Pointing Dies have proven themselves! Made from shock-resisting, high grade steel they assure many hours of hard, continuous usage. Fit your swaging machines with these rugged, S & S Pointing Dies, made to order on your specifications, they guarantee you service.



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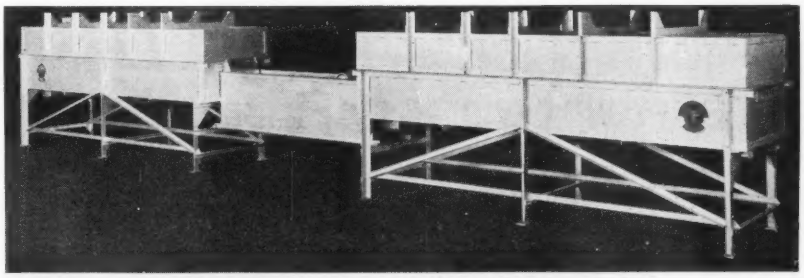

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This continuous, strand type hardening, quenching and tempering furnace for carbon steel wire is one of many automatic heat treating units built by Rockwell for clean or bright heat treatment of steel, stainless steel or non-ferrous metal wire. The work travels through muffle tubes under desired atmosphere; heating may be gas or electric. The unit may be furnished with unreeling stands and coiling equipment. Write for Bulletin No. 418 on batch and continuous wire mill furnaces.

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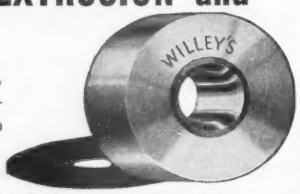

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A NEW method of sintering Alnico 5, a permanent magnet material, permits the design of intricate shapes with higher energy than previously possible. The sintering process permits economical production of small parts, finer grained and less brittle, with smooth surfaces and closed dimensional tolerances.

★ ★ ★

AN interesting application for an Alnico permanent magnet was a new wall-type can opener manufactured by the Rival Manufacturing Company, Kansas City, Mo. The magnet is attached to an adjustable arm on the side of the can opener. After the opener has cut off the lid, the magnet snaps it up and holds it tight until the can is removed.

★ ★ ★

MAJOR trend in the application of cemented carbide is its increasing use as an "end-product material, it was reported by Carboloy Company, Inc., of Detroit, a G-E manufacturing affiliate. In such applications it usually serves as a component part of machinery, equipment and other products to resist excessive wear, to prolong life, and to increase operating efficiency. Among such applications of Carboloy cemented carbide were bushings in automatic screw machines, line guides for wire and textiles, guides and bearings for fish rods and reels, lathe work rests, powdered-coal nozzles, paint scrapers, cams and cam followers in machinery, core pins for ceramic and powdered-metal industries, dial gauge indicators, brick mold liners, grinding-wheel molds, and paint-spray nozzle tips.

Aluminum Demand Ahead of Supply Throughout 1948*

CONTINUING strong demand for aluminum and its prod-

* Extracts from a year-end statement issued by Roy A. Hunt, President of the Aluminum Company of America.

LET

STANNOCHLOR

or

STANNOUS SULPHATE

solve your tinning problems

One of these two M & T chemicals will meet all your liquor finishing or immersion plating requirements . . . whether for acid or alkaline . . . white or bronze finish baths.

STANNOCHLOR and STANNOUS SULPHATE are stable . . . will not deteriorate with age in summer or in winter. Their use makes it possible to keep a stock on hand at all times . . . permits purchasing in large quantities for economy.

And, because they contain no water of crystallization, STANNOCHLOR and STANNOUS SULPHATE go further pound for pound.

Write for more complete information.

METAL & THERMIT CORPORATION

120 Broadway • New York 5, N.Y.

ucts, plus a combination of conditions which prevent adequate increases in production, provoked a tight supply-and-demand situation in the aluminum industry that persisted throughout 1948. It is probable that demand will continue to exceed supply for the early part of 1949 as well.

★ ★ ★

DROUGHTS throughout many areas of North America, coupled with unprecedented industrial and domestic requirements for electric power since the end of World War II, have hampered the aluminum industry for many months, as large amounts of steady electricity are required for aluminum production.

★ ★ ★

MILITARY requirements for the Air Force programs and other defense applications will have an increasingly substantial effect on the supply of aluminum for civilian use, as security needs must necessarily be given priority.

★ ★ ★

SERIOUS low water conditions in Canadian hydroelectric reservoirs mean that considerably less aluminum for imports into the United States will be available, especially during the early part of 1949.

★ ★ ★

ANOTHER factor limiting aluminum supply in 1949 is that Alcoa's smelting works at Niagara Falls, N. Y. will be permanently closed in 1949. This will reduce the company's smelting capacity by approximately 40 million pounds a year.

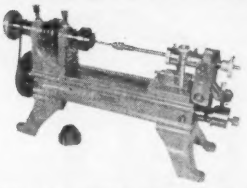
★ ★ ★

TO counter the effect of production losses from the above causes, Alcoa some months ago began erection of a smelting plant on the Gulf Coast at Point Comfort, Texas, which will use natural gas to generate the required electricity for aluminum production. This works should be in operation early in 1950. This natural-gas power plant will mark the first extensive peacetime use by Alcoa of electricity generated by other means than water-power to produce aluminum, except for a brief period

NEW ROOS

DIE ROOM EQUIPMENT

SEMI-AUTOMATIC POLISHER



MODEL OT - PATENT REGISTERED AND APPLIED FOR

Note these outstanding features for greater accuracy in polishing dies and for prolonged machine life!

(a) Quick opening spindle
(b) Pressure adjustor
(c) New cam assembly
(d) New style leather belt

NEW STYLE TAILSTOCK
To Fit Other Model
ROOS Polisher Model OT

MODEL OT

You can quickly and easily replace the tailstock on your old Roos Semi-Automatic Polisher with the New Model OT-Tailstock. Quotation on this new Tailstock furnished on request.

ROOS

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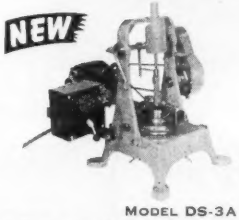

MODEL DS-3A

Offers you three improved features: a die rotating attachment; a time switch; and a reversing switch—which provide these advantages:

1. Die rotating attachment and time switch eliminate the formerly necessary constant attention by operator. Rotation of die is automatic, and machine shuts off automatically at end of time cycle.
2. Reversing switch permits rotation of the die in either direction.

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METALLOGRAPHIC POLISHERS

For preparation of fine metallographic specimens. A 1/8 H.P. motor turns the polishing wheel through a speed reducing, torque increasing V-belt drive. Several models are available. Write for Bulletin 90.

Eberbach & Son Company
LABORATORY APPARATUS & SUPPLIES
ANN ARBOR, MICH.
ESTABLISHED 1849

in the earliest days of the industry.

★ ★ ★

ALUMINUM in 1948 retained its position as the leading nonferrous metal of industry from the standpoint of volume produced. On the basis of preliminary figures for the first ten months of 1948, as furnished by The Aluminum Association, it is probable that production of primary (new) aluminum by the whole U. S. industry will be approximately 1,245,000,000 pounds for the full year.

★ ★ ★

THE distribution of Alcoa aluminum products by industries during 1948 has continued to parallel recent trends. Alcoa shipments to various industries during the year are estimated to be as follows: Building Products, 18 per cent; Transportation, 13 per cent; Cooking Utensils, 9 per cent; Machinery (electrical and general), 4 per cent; Household Appliances, 9 per cent; Power Transmission, 6 per cent; Shipments to Fabricators for Further Processing, 25 per cent; All Other Uses, 16 per cent.

★ ★ ★

Photoelectric Flame Failure Safeguard

FOR flame failure protection of semi-automatic and manually ignited industrial oil burners, **Combustion Control Corporation,** 77 Broadway, Cambridge 42, Mass., introduces Fireye System FF-3. System FF-3 includes Photoelectric scanner type 45PH5 and control type 24QJ5.

★ ★ ★

SCANNER type 45PH5 consists of phototube and vacuum tube amplifier housed in a dust-tight aluminum case. It is mounted on the burner mounting plate so that it has a clear view of the oil flame. Fireye continuously monitors the oil flame, and, when flame fails, instantly signals control type 24-QJ5 which cuts off the fuel supply and sounds an alarm.

★ ★ ★

CONTROL Type 24QJ5 consists of two relays and a power

The Oakite CrysCoat* Process

offers 5 big advantages for drawing ferrous rods and wire:

1. Longer die life
2. Shorter downtime
3. Greater rust-resistance
4. Cleaner, brighter wire
5. Increased production

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MATERIALS • METHODS • SERVICE

EASTWOOD WIRE
CENTRIFUGALLY-CAST FOR QUALITY

Phosphor Bronze — WIRE, FLAT
Nickel Silver — WIRE, ROD

Eastwood-Nealley CORPORATION
Belleville 9, New Jersey

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More shops are turning to this most satisfactory coating material. It is easy and safe to handle. Does not create dust nuisance.

Pins of wire which have been properly washed after the acid dip, sul coated and then coated with Borax have been satisfactorily drawn after remaining in storage for several weeks.

Borax coated wire used with proper lubricant will increase die life.

Demonstrate the effectiveness of Borax with a fair trial in your own shop as others have done.

Bulletin Submitted on Request

PACIFIC COAST BORAX COMPANY
NEW YORK • CHICAGO • LOS ANGELES

transformer housed in a dust-tight steel case. It is mounted on the burner control panel. It includes a safety start circuit which prevents the burner from cycling if flame is detected or simulated prior to ignition. Write the company for further details.

★ ★ ★

New Chrome Alloying Process for Steel Surfaces Developed

A LOW-COST process has been developed in England, said to be quite revolutionary, that makes possible alloying ordinary steel surfaces with chrome to produce high temperature, wear and corrosion resistant surfaces.

★ ★ ★

IT is being introduced in this country by the **Fusion Alloys Corporation,** 60 East 42nd St., New York City. The process consists of packing the parts in ordinary carburizing boxes filled with powder of chromium-rich content.

★ ★ ★

THE surface alloy has been found good for springs, nuts, bolts, tools and other wear resisting parts.

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Wardwell Braiders • Take-Up Stands • Twinners • Stranders • Re-Winding Equipment • Rubber Equipment • Miscellaneous Wire Manufacturing Equipment.

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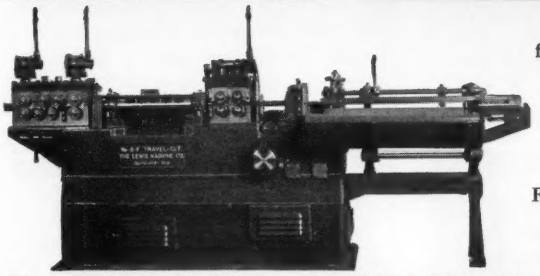

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Automatic
High Speed
Heavy Duty

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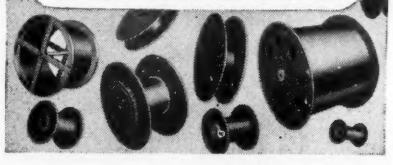

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New Bulletin on Barrett Lift-Trucks

BULLETIN 4883, just released, presents the improved line of Barrett Lift-Trucks. This 28-page bulletin illustrates in two colors and describes in detail hand lift-trucks in capacities from 1000 to 15,000 pounds. The new hydraulic lift-trucks are a part of this line. Design drawings and specifications are included.

★ ★ ★

CLOSE-UP views illustrate the advanced mechanical features of single stroke hand lift-trucks. These include: patented rear axle construction with oilless bearings; the easily operated lifting mechanism; the spring handle hold-up; the roller bearing latch catch; and the positive engagement of handle latch and lifting lever.

★ ★ ★

"SELECTING the Proper Model" is the title of a chapter of definite and practical help to lift-truck users, as is also the inquiry sheet included in the bulletin.

★ ★ ★

THE contents of Bulletin 4883 do not include Barrett Pallet Lift Trucks, which are shown in Bulletin P476; nor Barrett Power Ox electric lift-trucks, pallet trucks and tractors, which are covered in Bulletin 4861.

★ ★ ★

ANY or all of these bulletins may be obtained by requesting them by number from Barrett-Cravens Co., 4609 S. Western Blvd., Chicago 9, Illinois.

★ ★ ★

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Famous Wire Drawing Diamond Dies

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Appropriate profiles available for soft, medium and hard metals or to your specifications.

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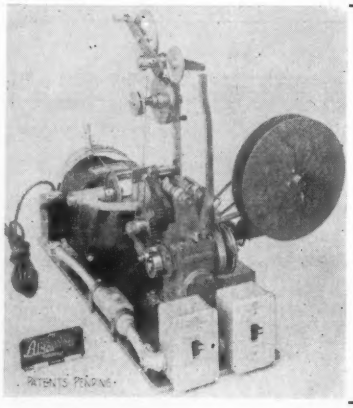
V. J. Boulin, Manager

Bulletin Describes New Home of G-E Silicones

A 12-PAGE bulletin (CDC-102) illustrating the **General Electric Company's** new silicone manufacturing facilities at Waterford, N. Y., has been issued by the Company's Chemical Department.

★ ★ ★

CONTAINING many interior and exterior views of the in-



A NEW MACHINE

"AIMCO" WIRE FORMING MACHINE 963 produces a sinuated form of ribbon from resistance wire for non-inductive electric heating units and resistors.

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Tel. COlumbus 5-1340

tricate mazes of tanks and pipes at the Waterford Plant, the bulletin is a pictorial introduction to the complexities of silicone manufacture rather than a source of technical information about these unique heat resistant materials. Included are brief descriptions of the outstanding characteristics and principal uses of G-E silicone resins, oils, greases, rubber, and water repellents. The closing paragraphs summarize the steps by which these five classes of products are made.

★ ★ ★

COPIES may be had by writing the General Electric Company, Chemical Department, Pittsfield, Mass.

★ ★ ★

Dillon Illustrates Dynamometer Uses in New Bulletin

CLEAR and interesting illustrations by actual photographs of Dillon Dynamometers in a wide range of uses, form an attractive feature of the new Bulletin D, just issued by the manufacturers, and said to be considered essential equipment in many industries as well as in the power and communications fields. New uses are constantly being reported by almost every industry, large or small who, as they become familiar with it, state that it has proven valuable in many different operations.

★ ★ ★

IT is a remarkable instrument—ruggedly constructed for measuring traction, tension, or weight from 0-500 lbs., to 0-20,000 lbs. with the closest accuracy. A distinct departure from ordinary "spring" measuring devices, it operates through deflection of a special alloy steel **beam,** and requires only .040" movement to indicate a full scale reading. There are no levers nor weights to adjust. Although tolerance between beams is less than .005" each instrument is individually calibrated.

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IT is fatigue protected—overload protected up to 25%—unaffected by temperature—and durably

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finished in baked-on gray enamel. It can be adjusted to fit every condition of use. Case is heavy metal. The large, clear dial is instantly read.

★ ★ ★

COPIES of the new Bulletin D may be had by addressing **W. C. Dillon & Company, Inc.,** 5410 W. Harrison St., Chicago 44, Illinois.

★ ★ ★

An ADVERTISER likes to know his ads have been read so please mention WIRE & WIRE PRODUCTS when writing him.

Industrial Diamond Association of America Letter

(*Continued from page 430*)

between the diamond die maker and the engineer, my own mechanics have never worked up much enthusiasm over drilling a small hole in a quarter carat diamond. If now we present the engineer with a hard one inch disc of metal into which we have correctly centered a whole natural diamond he may be able to produce a mass production technique whereby blocks of fully automatic machines will drill and polish dies on a really economical basis.

★ ★ ★

TO do this of course, the minimum weight stones allowing the maximum die bores will be used. In practice only sound close goods of high quality will be used and the specification for die contour will allow only just sufficient stone height to enable the entering wire to come on to the reduction zone, bell and approach will be formed by the mounting media itself. Examples of diamond dimensions to carat weight will illustrate the soundness of these points provided the reinforcing is adequate. Also note that the generally accepted diamond die shape for steel, nickel chrome and other rapid work hardening wires, is one that requires the greater stone dimensions by reason of the bearing length required and the small angled reduction zone.

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Manufacturers of Plastic Chemical Equipment

Wire Measuring...
PRODUCTIMETERS
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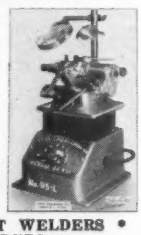

* FINE WIRE BUTT WELDERS *
* SPOT WELDERS *
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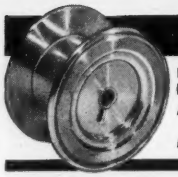

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IF we adopt the method of making the length of parallel bearing equivalent to the die diameter and the natural stone height to be equal to three times the die diameter, then adequate bearing length, reduction zone, relief and wall thickness is provided.

Carat Wgt.	Stone Hgt.	Die dia.
.1	.085 in.	.028 in.
.2	.108 in.	.036 in.
.3	.124 in.	.041 in.

★ ★ ★

SMALLER stones can be used for the above die bores when softer materials are drawn as the wider reduction angle and shorter bearing parallel for such die shapes allow decreased stone height.

★ ★ ★

I DO not suggest that the use of small diamonds for maximum die bores in reinforced settings is an original line of thought for although the present wide application is not many years old, I have used, adapted and tested this method for almost twenty years.

★ ★ ★

I DO not suggest that the idea to mass produce diamond dies on fully automatic machinery is entirely original for there is evidence* that American die manufacturers have long since recognized that the reinforcing technique opens up possibilities for mass production of diamond dies.

★ ★ ★

WHAT I have endeavored to state is that having tested all the associated conditions of diamond die manufacture and their use and abuse in the wire drawing mill, I am certain that we are correct in moving towards a mass production technique.

★ ★ ★

MODERN high speed wire drawing machines are very fine pieces of machinery but to be 100% efficient they must have first grade die sets, indifferent repolishing service and ill-balanced

*"The Wire Industry" London. "Wire Mill Practice" No. 4. The Diamond Wire Drawing Die. September 1948. W. F. G. Kerley.

★ ★ ★

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For Mechanical Purposes
Plain Polished, Tinned, Straightened and Cut Lengths
Fine Sizes — Special Wires — Strands and Cables — Spooled and Coiled Wires

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Florists	Stainless
Monel	Straightened and Cut
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LEWIS & SHUSTER Round and Shaped Wire Automatic Straightening and Cutting Machines.
NATIONAL MACHINERY EXCHANGE
128-138 MOTT ST. NEW YORK, N. Y.

sets may have 'got by' in older and slower machines but for consistency in the physical properties of wire produced by modern means there is little comparison.

★ ★ ★

THAT we have not greatly advanced along the road to the mass production of high grade diamond dies can be gauged by the new die price lists. If we check our die maintenance costs plus the extra costs of allowing sufficient stone weight in order to provide for subsequent re-bores when purchasing new dies, then if we are honest, we must see that the hard and exacting conditions of the modern wire mill demands something more economical and here I commend further application of your excellent trait on which I commenced this paper (i.e.) that we consider the end and not its means.

★ ★ ★

USING whole natural diamond crystals in reinforced settings we shall develop fully automatic machinery that will drill and polish diamond wire drawing dies on such an economical basis that when maximum bores for minimum carat weight are used, the consideration of re-bores and maintenance will not be provided for. This will be the practice in high grade wire production of the near future where new drawing dies when worn to permissible tolerance **judged by metallurgical consideration of wire quality,** will be replaced by further new dies.

★ ★ ★

HAVING taken much more space than first intended in this paper, I cannot do more than briefly mention the various applications of diamond tools for watch production that I have developed. Here I would offer no recommendation for working diamonds after setting without careful consideration of crystal orientation. In fact the success of the economical production of fine hairspring strip, pivot forming and burnishing and other applications depends entirely on the correct orientation of the grain to the workpiece.

★ ★ ★

WIRE DRAWING EQUIPMENT WANTED
One machine to draw copper from ¼" rod to No. 18 B&S and one machine to draw from No. 18 B&X to No. 40 B&S. Machines must be in good condition and reasonably priced. State age, make, range and number of dies. Reply to Box 527.

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This book is concerned with industrial diamonds and other precious stones. It gives information about their production and qualities, their cutting and uses and, of course, devotes considerable space to the use and manufacture of diamond dies for wire drawing. One chapter is devoted to diamond powders.

Besides being profusely illustrated, there are many reference tables providing much useful data. An effort has been made to treat every phase of the subject in a practical and helpful manner. If you are making diamond dies or tools, or using them, you cannot afford to be without this book.

You may order it from this office. Just send check or order to:

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300 Main Street Stamford, Conn.

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Norton Co., Worcester, Mass.

ACID INHIBITORS—
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.

ACID-PROOF CONSTRUCTION
Haveg Corporation, Newark, Del.
Sauereisen Cements Co., Pittsburgh, Pa.

ANNEALING MACHINES—Open Flame
Syncro Machine Co., Perth Amboy, N. J.

ANNEALING POTS AND BOXES—
National Annealing Box Co., Washington, Penna.
Scudder, E. J., Foundry & Machine Co., Trenton, N. J.

ARMORING EQUIPMENT—
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machy., Inc., Pawtucket, R. I.

BAKERS—Rod and Wire
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Morgan Construction Co., Worcester, Mass.
Ross, J. O., Engr. Corp., New York, N. Y.

BAR STOCK—Stainless Steel
Armco Steel Corp., The, Middletown, Ohio.
American Steel & Wire Company, Cleveland Chicago, New York.
Columbia Steel Co., San Francisco, Calif
U. S. Steel Export Company, New York, N. Y.

BOBBINS—Braider & Wire Weaving
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

BORAX—Wire Drawing
Pacific Coast Borax Corp., New York, N. Y.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BRAKES—Pneumatic
Entwistle, Jas. L. Co., Pawtucket, R. I.

CABLE LACQUERING OVENS—
Industrial Ovens, Inc., Cleveland, O.

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

CASTINGS—Wire Mill
Scudder, E. J., Fdry. & Mach. Co., Trenton, N.J.

CEMENTS—Acid Proof
Sauereisen Cements Co., Pittsburgh, Pa.

CEMENTS—Refractory
Norton Co., Worcester, Mass.
Sauereisen Cements Co., Pittsburgh, Pa.

CHEMICALS—Cleaning
(See Cleaners—Metal)

CLEANERS—Metal
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Phila., Pa.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corp., Brooklyn, N. Y.
Metal & Thermit Corp., New York, N. Y.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.
Standard Industrial Compounds Co., Inc., Chicago, Ill.

CLEANING & PICKLING EQUIP.—
Cleveland Tramrail Div., of the Cleveland Crane & Engineering Co., Wickliffe, O.
Haveg Corp., Newark, Del.
Metal & Thermit Corp., New York, N. Y.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

CLOTH TESTERS—
Scott Testers, Inc., Providence, R. I.

CLOTH—WIRE, All Metals
Roebling's, John A. Sons, Co., Trenton, N. J.
Wickwire Spencer Steel Division, Colorado Fuel & Iron Corp., Buffalo, N. Y.

COATING COMPOUNDS—
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Inc., Chicago, Ill.

COILERS—Sheet, Strip and Wire
Entwistle, Jas. L. Co., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J. Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Corp., Cleveland, Ohio.

COLD HEADERS—
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Diamond
Magnus Chemical Co., Garwood, N. J.

COMPOUNDS—Metal Finishing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Metal & Thermit Corp., New York, N. Y.

COMPOUNDS—Rust Preventing
American Chemical Paint Co., Ambler, Pa.
American Lanolin Corp., Lawrence, Mass.
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.

COMPOUNDS—Rust Removing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Inc., Chicago, Ill.

COMPOUNDS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corporation, Brooklyn, N. Y.
Miller, R. H. Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Pacific Coast Borax Corp., New York, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Inc., Chicago, Ill.
Swift & Company, Chicago, Ill.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

CORROSION PREVENTIVES
Angier Corp., The, Framingham, Mass.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, New York.
Vascoloy-Ramet Corp., North Chicago, Ill.
Willey's Carbide Tool Co., Detroit, Mich.

CUTTING TOOLS—Wire
Porter, H. K., Inc., Everett, Mass.

DIAMONDS—Industrial
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Champion Diamond Co., New York, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDERS—
Champion Diamond Co., New York, N. Y.
Eastern Carbide Corp., New Rochelle, N. Y.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND TOOLS—
Carboloy Co., Inc., Detroit, Mich.
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Carbide
(See Dies—Tungsten Carbide)

DIES—Cold Heading
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio.
Vascoloy-Ramet Corp., No. Chicago, Ill.

DIES—Diamond
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Cochaud Wire Die Corp., New York, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Extrusion
Carboloy Co., Inc., Detroit, Mich.
L & H Die Co., Royal Oak, Mich.
Metal Carbides Corporation, Youngstown, Ohio.
Robertson, John, Co., Brooklyn, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Eyelet
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.

DIES—Pointing
Sjogren Tool and Machine Co., Auburn, Mass.

DIES—Repairs & Re-Cutting
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
L & H Die Co., Royal Oak, Mich.
Metal Carbides Corp., Youngstown, O.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Special Shapes, Etc.
Eastern Carbide Corp., New Rochelle, N. Y.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.

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DIES—Tantalum Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.

DIES—Tube Drawing
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
L & H Die Co., Royal Oak, Mich.
Metal Carbides Corp., Youngstown, O.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tungsten Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
L & H Die Co., Royal Oak, Mich.
Metal Carbides Corp., Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DRAW BENCHES—
(See MACHINERY—Draw Benches)

DRUMS—Flange Steel
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., The, Paterson, N. J.

DRYING EQUIPMENT—
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.
Modern Plastic Machinery Corp., Lodi, N. J.
Rockwell, W. S. Co., Fairfield, Conn.
Ross, J. O., Engineering Corp., New York, N. Y.

ENGINEERS—Consulting Hot Galvanizing
Wallace G. Imhoff Co., The, Los Angeles, Calif.

ENGINEERS—Consulting Spring Design
Carlson, Co., The, New York, N.Y.

ENGINEERS—Consulting Wire Mill
Lewis, Kenneth B., Worcester, Mass.

EQUIPMENT—Insulation Testing
Davis, R. L., Elec. Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FLUXES—Soldering
American Chemical Paint Co., Ambler, Pa.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Parkin, Wm. M. Co., Pittsburgh, Pa.

FRICTION PAY-OFF STANDS—
Industrial Ovens, Inc., Cleveland, Ohio.

FURNACES—Annealing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engr. Co., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Automatic
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Brazing
Electric Furnace Co., Salem, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Electric
Eisler Engineering Co., Newark, N. J.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio.

FURNACES—Galvanizing Equipment
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Hard'ing & Temp'ing
Ajax Electric Co. Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engr. Co., The, Cleveland, Ohio.

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio.
Robertson, John, Co., Brooklyn, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Non-Oxidizing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Normalizing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Pot (Oil, Gas, Electric)
Ajax Electric Co., Inc., Philadelphia, Pa.

FURNACES—Resistance Heating, Strand
Trauwood Engineering Co., Cleveland, Ohio.

FURNACES—Salt Bath
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corporation, Toledo, O.
Trauwood Engineering Co., The, Cleveland, Ohio.

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., The, Cleveland, Ohio.
Eisler Engineering Co., Newark, N. J.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corporation, Toledo, O.
Trauwood Engineering Co., The, Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

GALVANIZING EQUIPMENT—
Steel Equipment Co., Cleveland, Ohio.
Wean Equipment Corp., Cleveland, Ohio.

GALVANIZING KETTLES—
National Annealing Box Co., Washington, Penna.

GRINDERS—Roll
Norton Co., The, Worcester, Mass.

HAMMERS—Swaging
Sjogren Tool and Machine Co., Auburn, Mass.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, Ohio.

HOOKS—Pickling and Liming
Gordon, Clark E., Detroit, Mich.
Youngstown Welding & Engineering Co., Youngstown, Ohio.

INHIBITORS—Pickling
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.

INSULATING LACQUERING SYSTEMS—Continuous
American Insulating Machine Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.

INSULATING MATERIALS—
Du Pont de Nemours, E. I., Co., Wilmington, Del.
Martin, Glenn L., Company, Baltimore, Md.
Owens Corning Fiberglas Corp., Toledo, O.
Twitchell, E. W., Philadelphia, Pa.

LATHES—Die Reaming
Carboloy Co., Inc., Detroit, Mich.
Morgan Construction Co., Worcester, Mass.
Roos, Tool & Mfg. Co., Montclair, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co. Waterbury, Conn.

LIME—
Warner Co., Philadelphia and Bellefonte, Pa.

LININGS—Acid and Alkali Proof
Haveg Corp., Newark, Del.
Sauereisen Cements Co., Pittsburgh, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Inc., Chicago, Ill.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUMBER—Wire Mill, for lagging and car blocking.
North Anson Reel Co., North Anson, Maine

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

MACHINERY—Brazing
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Bunching
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Nilson, A. H. Machine Co., The, Bridgeport, Conn.

MACHINERY—Cable, Rope Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Boyd & Sons Manufacturing Co., Phila., Pa.
Rockwell, W. S., Co., Fairfield, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

WHERE TO BUY, Continued

MACHINERY—Coilers
Boyd & Sons Manufacturing Co., Phila., Pa.
Eisler Engineering Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (used), New York, N. Y.
New England Butt Co., Providence, R. I.
Ruesch, H. J. Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.
Wire & Textile Machinery, Inc., Pawtucket, R. I.

MACHINERY—Copper Wire Drawing and Rolling
American Insulating Mach'y Co., Phila., Pa.
National Machinery Exchange (used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cutting
Eisler Engineering Co., Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio.
Mettler Machine Tool, Inc., New Haven, Conn.
National Mach'y Exch. (Used) New York, N. Y.
Nilson Machine Co., A. H., Bridgeport, Conn.
Porter, H. K., Inc., Everett, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Die Making
Carboloy Co., Inc., Detroit, Mich.
Kelly Wire Die Corp., New York, N. Y.
Roos, Tool & Mfg. Co., Montclair, N. J.
Wayne Wire Die Co., Hillside, N. J.

MACHINERY—Draw Benches
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Edging
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Extruding
Modern Plastic Machinery Co., Lodi, N. J.
Robertson, John, Co., Brooklyn, N. Y.
Royle, John, & Sons, Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Fence
Blashill, Arthur, Woodstock, Ont., Canada.
Glader, Wm., Machine Works, Chicago, Ill.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Filament Coil Winding
Eisler Engineering Co., Newark, N. J.

MACHINERY—Flat Wire
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Galvanizing
(See Galvanizing Equipment)

MACHINERY—Galvanizing Wire
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

MACHINERY—Gang Winders
Entwistle, Jas. L. Co., Pawtucket, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y Co., Phila., Pa.
Modern Plastic Machinery Co., Lodi, N. J.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
Robertson, John Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
Robertson, John Co., Brooklyn, N. Y.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Looms, Wire Weaving
Bruckner-Mitchell, Inc., New York, N. Y.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Material Handling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MACHINERY—Measuring Wire & Cable
Durant Mfg. Co., Milwaukee, Wis.
Entwistle, Jas. L. Co., Pawtucket, R.I.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Black Industries, Cleveland, Ohio.
Eastern Nail Co., Providence, R. I.
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Panning
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I

MACHINERY—Pickling
Gordon, Clark E., Detroit, Mich.
Youngstown Welding & Engineering Company, Youngstown, Ohio.

MACHINERY—Pointing
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rod Mill
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rolling Mill
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rubber Insulating
Royle, John & Sons, Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Rubber Tubing and Straining
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Screw Wire
National Mach'y Exch. (Used), New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila, Pa.
Black Industries, Cleveland, Ohio.
Bruckner-Mitchell, Inc., New York, N. Y.
Eastern Nail Co., Providence, R. I.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
New England Butt Co., Providence, R. I.
Ruesch, H. J. Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Spooling
American Insulating Mach'y Co., Phila., Pa.
Boyd & Sons Manufacturing Co., Phila., Pa.
Eisler Engineering Co., Newark, N. J.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Modern Plastic Machinery Co., Lodi, N. J.
National Mach'y Exch. (Used), New York, N.Y.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O. Waterbury, Conn.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Lewis Machine Co., The, Cleveland, Ohio.
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N.Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Stranding
Hughesville Machine & Tool Co., Hughesville, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Ruesch, H. J., Machine Co., Newark, N. J.
Steel Equipment Co., Cleveland, Ohio.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Swaging
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury-Farrel Foundry & Machine Co. Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Testing Physical
Eberbach & Son Co., Ann Arbor, Mich.
Scott Testers, Inc., Providence, R. I.

MACHINERY—Testing Equipment—Sparkers
Davis, R. L. Elec. Co., Wallingford, Conn.
Dillon, W. C. & Co., Inc., Chicago, Ill.
Entwistle, Jas. L., Pawtucket, R. I.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
Ruesch, H. J.. Machine Co., Newark, N. J.

MACHINERY—Welding Wire
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Eisler Engineering Co., Newark, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

MACHINERY—Wind-up (Constant Tension, Variable Speed)
Industrial Ovens, Inc., Cleveland, Ohio.
Modern Plastic Machinery Co., Lodi, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Bending
Eisler Engineering Co., Newark, N. J.

MACHINERY—Wire Drawing
American Insulating Mach'y Co., Phila., Pa.
Eisler Engineering Co., Newark, N. J.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co. Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Wire Forming
Eisler Engineering Co., Newark, N. J.
National Mach'y Exch. (Used), New York, N.Y.
Nilson Machine Co., A. H., Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wood Screw
National Mach'y Exch. (Used), New York, N.Y.

MACHINERY—Wrapping Wire Coils
Angier Corporation, Framingham, Mass.

MATERIAL HANDLING EQUIPMENT
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MATERIAL—Resistance Heating Strand
Trauwood Engineering Co., Cleveland, Ohio.

MILLS—Tandem, Rolling & Edging
Torrington Mfg. Co., Torrington, Conn.

NAILS—Wire
American Steel & Wire Co., Cleveland, Chicago, New York
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling, John A. Sons Co., Trenton, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.
U. S. Steel Export Co., New York, N. Y.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Chase Brass & Copper, Waterbury, Conn.
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.

OVENS—Cable Lacquering
American Insulating Mach'y Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.

OVENS—Dehydrogenizing
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.

OVENS—Industrial
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Industrial Ovens, Inc., Cleveland, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.
Ross, J. O., Engr. Corp., New York, N. Y.

OVENS—Welding Rod Coating
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Industrial Ovens, Inc., Cleveland, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.
Ross, J. O., Engr. Corp., New York, N. Y.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PANS—Lead and Spelter
National Annealing Box Co., Washington, Pa.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Creped Wrapping
Angier Corp., The, Framingham, Mass.
Crepe-Kraft Company, The, Division National Waterproof Papers, Inc., Newark, N. J.

PAPER—For Coil Wrapping and Corrosion Prevention
Angier Corporation, The, Framingham, Mass.
Crepe-Kraft Company, The, Division National Waterproof Papers, Inc., Newark, N. J.

PAPER TESTERS—
Scott Testers, Inc., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine & Rommel, Washington, D.C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.

PICKLING—Hooks, etc. Acid Resisting
Gordon, Clark E., Detroit, Mich.

PICKLING TANK LININGS—
Haveg Corp., Newark, Del.
Sauereisen Cements Co., Pittsburgh, Pa.

PIPES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

PLASTIC TESTERS—
Scott Testers, Inc., Providence, R. I.

PNEUMATIC CYLINDERS
Entwistle, James L. Co., Pawtucket, R. I.

POTS—Lacquer
Industrial Ovens, Inc., Cleveland, Ohio

POTS—Lead Melting
National Annealing Box Co., Washington, Pa.
Robertson, John, Co., Brooklyn, N. Y.

POWDER—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Inc., Chicago, Ill.

PRESSES—Hydraulic and Mechanical
Robertson, John, Co., Brooklyn, N. Y.

PRESSES—Lead
Robertson, John, Co., Brooklyn, N. Y.

PRESSURE VESSELS—
National Annealing Box Co., Washington, Pa.

PULLERS AND GRIPS—For Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.

PUMPS—Hydraulic
Robertson, John, Co., Brooklyn, N. Y.

REEL AND TENSION STANDS—
Davis, R. L. Electric Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Ovens, Inc., Cleveland, Ohio.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Drawn Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS & SPOOLS—Collapsible
Entwistle, Jas. L. Co., Pawtucket, R. I.

REELS & SPOOLS—Steel
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS AND SPOOLS—Shipping and Shop
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg., Co., The, Hazardville, Conn.
Clark, J. L., Mfg. Co., Rockford, Ill.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
North Anson Reel Co., North Anson, Maine

REELS—Metal Bound
Durkee Mfg. Co., Pine River, Minn.
Hubbard Spool Co., Chicago, Ill.
North Anson Reel Co., North Anson, Maine

REELS—Takeoff
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg., Co., The, Hazardville, Conn.
Clark, J. L., Mfg. Co., Rockford, Ill.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
North Anson Reel Co., North Anson, Maine

REELS—Vulcanizing & Impregnating
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Wire Drawing
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Wire Mill
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg., Co., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
North Anson Reel Co., North Anson, Maine

REELS & SPOOLS—Wooden
Acrometal Products, Inc., Minneapolis, Minn.
American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., Inc., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
North Anson Reel Co., North Anson, Maine

REFRACTORIES—High Temperature
Norton Company, Worcester, Mass.

RESISTANCE HEATING—Annealing, Patenting, Etc.
Trauwood Engr. Co., Cleveland, Ohio.

ROD BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Rockwell, W. S., Co., Fairfield, Conn.
Ross, J. O., Engineering Corp., New York, N.Y.

RODS—Nickel Alloy
Eastwood Nealley Corp., Belleville, N. J.
International Nickel Co., Inc., New York, N.Y.

RODS—Stainless Steel
Armco Steel Corp., The, Middletown, Ohio.

RODS—Wire—Non-Ferrous
Eastwood Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire, Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

WHERE TO BUY, Continued

ROPE—Wire
American Steel & Wire Company, Cleveland, Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Roebling's John A., Sons Co., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire-Spencer Steel, Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott Testers, Inc., Providence, R. I.

RUST PROOF COMPOUNDS—
(See Compounds—Rust Preventing)

RUST REMOVING COMPOUNDS—
(See Compounds—Rust Preventing)

SATURATION SYSTEMS—
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc., Pawtucket, R. I.

SHEET—Steel
Armco Steel Corp., The, Middletown, Ohio.
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

SOAPS—Industrial and Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H. Co., Inc., Homer, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Inc., Chicago, Ill.
Swift & Company, Chicago, Ill.

SOLVENT RESIN SYSTEMS—Experimental
Industrial Ovens, Inc., Cleveland, Ohio.

STAMPINGS—Steel
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass and Non-Ferrous
Chase Brass & Copper, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.

STRIP—Steel
Armco Steel Corp., The, Middletown, Ohio.
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Roebling's, John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

SWIFTS—Take-off
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., Paterson, N. J.

TANKS—Compound
Atlas Mineral Products Co. of Pa., Mertztown, Pa.
Haveg Corp., Newark, Del.
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Haveg Corp., Newark, Del.
Rockwell, W. S., Co., Fairfield, Conn.
Sauereisen Cements Co., Pittsburgh, Pa.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.
Rockwell, W. S., Co., Fairfield, Conn.
National Annealing Box Co., Washington, Pa.

TINSEL—Cords, Decorative
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, New York

TINSEL—Electric Conductor
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, New York

TINSEL—Electric Resistance
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, New York

TINSEL—Lame, Silver and False Gold
Hudson Wire Co., Ossining, N. Y
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, New York

TINSEL—Thread, Silver and False Gold
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, New York

TINSEL—Thread, Decorative
Hudson Wire Co., Ossining, N. Y.
Montgomery Co,, The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, New York

TOOLS—Wire Cutting
Porter, H. K., Inc., Everett, Mass.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TRAVERSES—For Reels
Entwistle, James L. Co., Pawtucket, R. I.
Hubbard Spool Company, Chicago, Ill.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

TRAVERSE MECHANISMS—
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

TUBE BENDERS AND FORMERS—
Ruesch, H. J., Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago Ill.

WIND-UP AND UNWIND SYSTEMS—Continuous
American Insulating Mach'y Co., Phila., Pa.
Davis R. L. Electric Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

WIRE—Aluminum
Aluminum Co. of America, Pittsburgh, Pa.
Malin & Co., Cleveland, Ohio.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Cold Heading
Armco Steel Corp., The, Middletown, Ohio.
American Steel & Wire Co., Cleveland-Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Electric
Chase Brass & Copper, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Malin & Co., Cleveland, Ohio.

WIRE—Enameled for Coils
North American Philips Co., Inc., New York, New York
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Armco Steel Corp., The, Middletown, Ohio.
American Steel & Wire Co., Cleveland-Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper, Waterbury, Conn.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div. of Colorado Fuel & Iron Corp., Buffalo, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Music
American Steel & Wire Co., Cleveland-Chicago, New York
Columbia Steel Co., San Francisco, Calif.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., Cleveland, Ohio.
U. S. Steel Export Co., New York, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

WIRE—Nickel & Nickel Alloy
Eastwood-Nealley Corp., Belleville, N. J.
International Nickel Co., Inc., New York, N.Y.

WIRE—Nickel Silver and Phosphor Bronze
Chase Brass & Copper, Waterbury, Conn.
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.
Malin & Co., Cleveland, Ohio.

WIRE—Non-Ferrous to Specification for Special Purposes
Chase Brass & Copper, Waterbury, Conn.
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.
North American Philips Co., Inc., New York, New York.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
American Steel & Wire Co., Cleveland-Chicago, New York.
Armco Steel Corp., The, Middletown, Ohio.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Indiana.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Il.
U.S. Steel Export Co., New York, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Stainless Steel
American Steel & Wire Co., Cleveland-Chicago, New York
Armco Steel Corp., The, Middletown, Ohio.
Columbia Steel Co., San Francisco, Calif.
Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
U. S. Steel Export Co., New York, N. Y.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Straightening and Cutting—
Pittsburgh Cut Wire Co., Pittsburgh, Pa.
Wickwire Brothers, Inc., Cortland, N. Y.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE CLOTH—Industrial
Roebling's John A., Sons Co., Trenton, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

WIRE TESTERS—
Scott Testers, Inc., Providence, R. I.

WIRE, WEAVING—Non-Ferrous
Chase Brass & Copper, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.

WRAPPING PAPER—Creped
Angier Corporation, Framingham, Mass.
Crepe-Kraft Company, The, Division National Waterproof Papers, Inc., Newark, N. J.

YARNS & TAPES—
Du Pont de Nemours, E. I., Co., Wilmington, Delaware
Owens Corning Fiberglas Corp., Toledo, Ohio.
Twitchell, E. W., Philadelphia, Pa.

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

The WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON 3, NEW JERSEY, U. S. A.

WATSON

ELECTRICAL WIRE AND CABLE AND WIRE ROPE MACHINERY

UNIFORM-TENSION CONTINUOUS TAKEUPS TYPE "D-C"

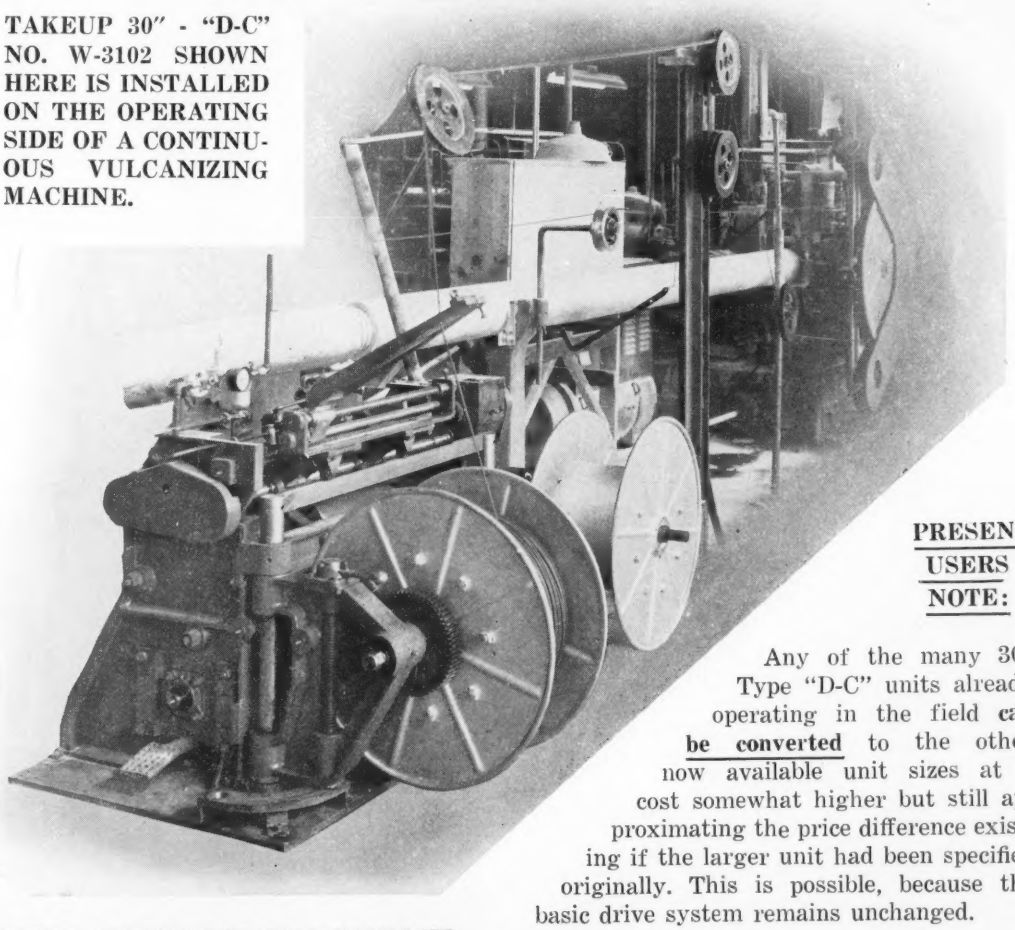
UNFAILING CONTINUOUS HIGH-SPEED WINDING PERFORMANCE YEAR AFTER YEAR, IN CONNECTION WITH ALL MANNERS OF CONTINUOUS PROCESS WINDING ON REELS, HAVE CAUSED THESE UNITS TO BECOME THE ACCEPTED AND PREFERRED STANDARD WHEREVER SUCH OPERATING CONDITIONS MUST BE MET.

Most widely known is their use in combination with CONTINUOUS VULCANIZING and SYNTHETIC JACKET EXTRUSION processes where **continuous uninterrupted uniform tension winding** is **absolutely essential,** however, they are in use and offer equal advantage in connection with other "continuous or long-run" process requirements.

New installations are generally provided with this type of takeup, but they are also being acquired for earlier installations where original takeup-performance proved inadequate.

Location is a matter of customers preference. Drive is usually from extruder capstan by drive provided by us with the units. Units may also be self-powered.

TAKEUP 30" - "D-C" NO. W-3102 SHOWN HERE IS INSTALLED ON THE OPERATING SIDE OF A CONTINUOUS VULCANIZING MACHINE.



PRESENT USERS NOTE:

Any of the many 30" Type "D-C" units already operating in the field **can be converted** to the other now available unit sizes at a cost somewhat higher but still approximating the price difference existing if the larger unit had been specified originally. This is possible, because the basic drive system remains unchanged.

THE THREE SIZE VARIATIONS NOW AVAILABLE ARE:

1.) **TAKEUP 30" Type "D-C".**	The original design for reels of up to 30" Flange Diameter. Generally preferred for high speed performance.
2.) **30" & 42" COMBINATION.**	For continuous high-speed performance with reels to 30" Flange **also** for intermittent 42" Reel operation at lower speeds winding larger product.
3.) **TAKEUP 36" Type "D-C".**	Similar to original 30" Size, but arranged to operate at moderate speeds with larger product. Generally operates within speed range of 40 to 400 Feet per Minute.

* * *

Descriptive Machine Bulletin available to all prospective users. Parts List available to all present users.

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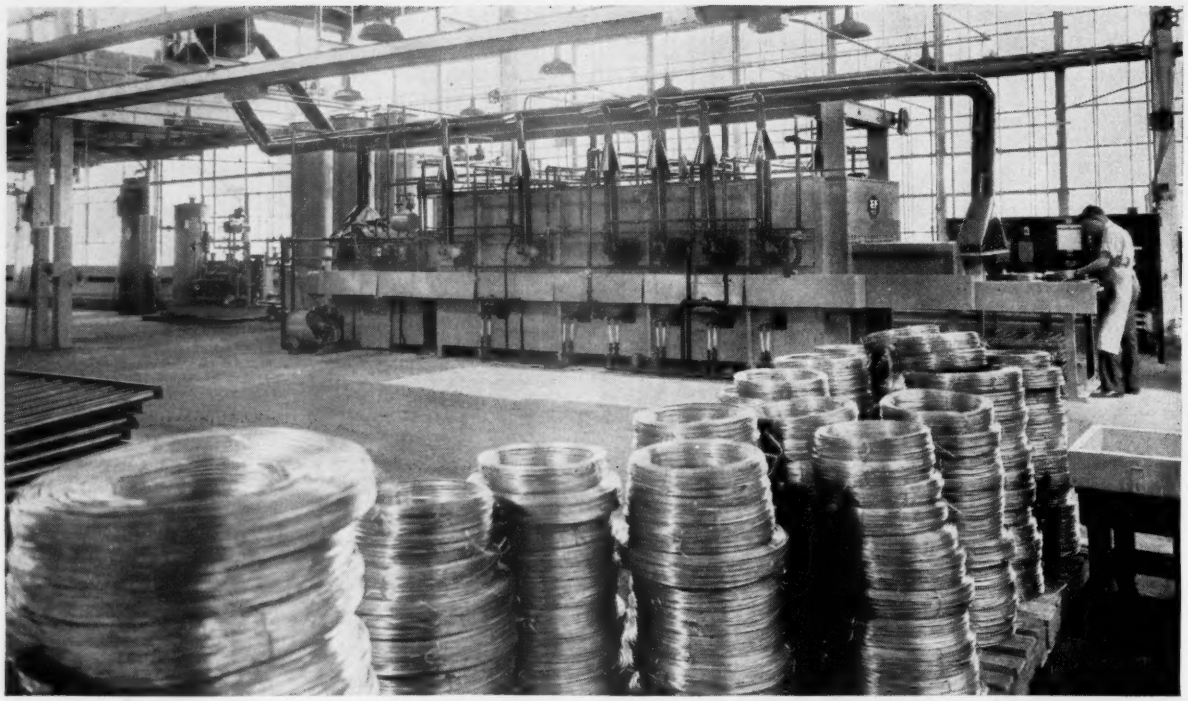


An EF gas fired radiant tube, roller hearth furnace clean and scale-free annealing nickel-silver and other alloy wire.

EF FURNACES FOR ANNEALING WIRE IN COILS, IN STRANDS ON REELS OR ON SPOOLS

High or low carbon wire, stainless steel—copper—brass—and other ferrous and nonferrous wire is being scale-free annealed, bright annealed or normalized, uniformly and continuously in EF furnaces. EF furnaces feature many service proved advantages conceived and perfected by the EF engineers and available only in EF design. These include the EF radiant tube and EF heat exchanger which combine to assure extremely high combustion efficiency; EF heavy, cast alloy electric heating elements, EF roller design and mounting, EF special atmosphere generators, and many other devices that assure uniform temperatures throughout the furnace, accurate control of heat within the required limits, low maintenance cost, high hourly output and dependable trouble-free operation.

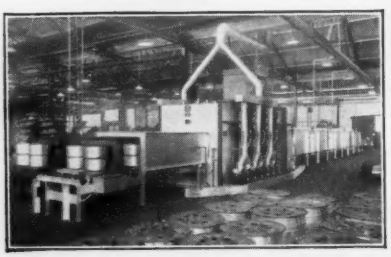
EF furnaces are built in many different types, for performing a wide variety of heating processes. Sizes to meet any production requirement. Let the EF engineers work with you on your next wire furnace problem.

EF

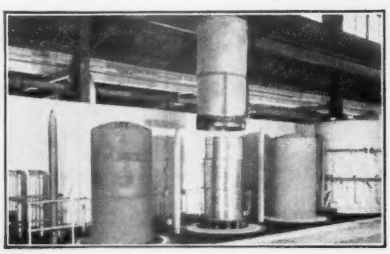
THE ELECTRIC FURNACE CO.

GAS FIRED, OIL FIRED AND ELECTRIC FURNACES FOR ANY PROCESS, PRODUCT OR PRODUCTION

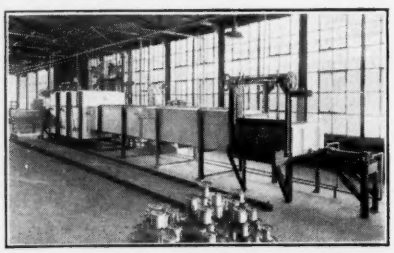
WILSON STREET *Salem - Ohio*



An EF combination gas fired radiant tube and electric furnace bright annealing 2500 pounds of copper wire per hour.



EF gas fired bell and other batch and continuous type furnaces are available for all wire treating processes.



EF electrically heated continuous special atmosphere furnace bright annealing fine copper wire on small spools.

MY 49

UMI